Sears

owners manual

AUTOMOTIVE ANALYZER

MODEL NO. 161.21042

SAFETY RULES
INTRODUCTION
OPERATION

FOR 12 AND 24 VOLT
IGNITION SYSTEMS

Sears, Roebuck and Co., Chicago, Ill. 60607 U.S.A.
and Simpsons Sears Limited, Toronto

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MANUFACTURING SPECIFICATIONS

In performing the tests described in this manual, it is important to follow manufacturer's specifications for the vehicle being tested whenever possible. These specifications can be found in the vehicle manufacturer's service manual or in any of the following publications:

A.E.A. Tune-Up Charts
Automotive Electric Assn.
1301 W. 22nd St., Suite 202
Executive Plaza Building
Oak Brook, Illinois 60521

Chilton's Auto Repair Manual
Chilton Company
56th and Chestnut Streets
Philadelphia, Pennsylvania 19139

GM Diagnosis and Repair Manual
GM DR Manual Headquarters
P.O. Box 1185
Southfield, Michigan 48075

Motor's Auto Repair Manual
250 W. 55th Street
New York, New York 10019

National Service Data Book
National Automotive Service, Inc.
Div. Glenn Mitchell Manuals, Inc.
Box 10465
San Diego, California 92110

RULES FOR SAFE AUTOMOTIVE TESTING
READ CAREFULLY

1. Read this Owner's Manual and these Rules For Safe Automotive Testing carefully. Failure to follow instructions and safety rules could result in serious bodily injury and/or damage to the instrument.

2. Before starting the engine, set the parking brake and place gear selector in neutral on standard transmission or park on automatic transmission.

3. The carbon monoxide in exhaust gas is highly toxic. To avoid asphyxiation, always operate vehicle in a well-ventilated area. If vehicle is in an enclosed area, exhaust should be routed directly to the outside via leakproof exhaust hose.

4. When operating any test instrument from an auxiliary battery, connect a jumper wire between the negative terminal of the auxiliary battery and ground on the vehicle under test. When working in a garage or other enclosed area, auxiliary battery should be located at least 18 inches above the floor to minimize the possibility of igniting gasoline vapors.

5. An automobile battery is capable of producing very high currents. Therefore, exercise reasonable care when working near the battery to avoid electrical connections through tools, wristwatch, etc.

6. Avoid contact with battery electrolyte. It can eat holes in clothing, burn skin and cause permanent damage to eyes. Always wear splash proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. In the case of eye contact, seek medical aid.

7. The gases generated by a charging battery are highly explosive. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is charging. Any room or compartment containing charging batteries should be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb the battery charger connections while battery is charging, and always turn charger off before disconnecting the battery clips. When removing or reconnecting battery cables, make sure ignition switch and all accessories are turned off.

8. Never add acid to a battery once the battery has been placed in service. Doing so may result in dangerous spattering of electrolyte.

9. Keep hands, hair, necktie, loose clothing and test leads well away from fan blade, fan belt, power steering belt, air conditioner belt and other moving engine parts, as serious injury could result from entanglement.

10. Do not touch hot exhaust manifold, radiator or high-voltage spark plug and coil terminals. Spark voltages are not normally lethal but an involuntary jerk of the hands or arms caused by electrical shock may result in injury.

11. Never look directly into carburetor throat while engine is cranking or running. A sudden backfire can cause serious burns.

12. To avoid the possibility of a flash fire, do not smoke or permit flame or spark to occur near carburetor, fuel line, fuel filter, fuel pump or other potential sources of spilled gasoline or gasoline vapors.

13. Never remove radiator cap while the engine is hot. Hot coolant escaping under pressure can cause serious burns.

14. The jack supplied with the vehicle should be used only for changing wheels. Never crawl under car or run engine while vehicle is on jack.

introduction

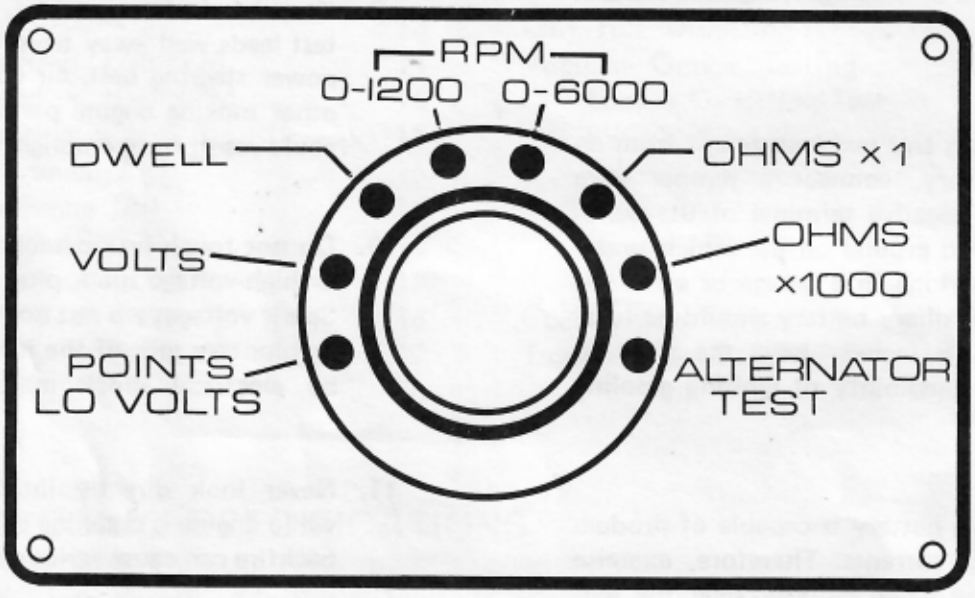
The Model 161.21042 Automotive Analyzer will perform the tests and measurements involved in engine tune-up and electrical system testing on 12 and 24 volt ignition systems. It will measure RPM, Dwell, Volts Point Condition, Amperes, Alternator Condition and High and Low Ohms.

It will work on conventional and electronic ignition systems. Hook-up is made easy by the clamp-on inductive tachometer lead. Works on any engine without the need of a Cylinder selector switch. The big 8" wide meter has 11 direct reading color coded scales.

FUNCTION SELECTOR KNOB POSITIONS

THE FUNCTION SELECTOR KNOB TEST POSITIONS ARE ARRANGED IN A LOGICAL ORDER TO ENABLE YOU TO DO ENGINE TUNE-UP AND ELECTRICAL SYSTEM TROUBLE SHOOTING IN A RECOMMENDED SEQUENCE.

AS THE VARIOUS TESTS ARE MADE, CORRECT ANY DEFECTS OR VARIANCE FROM THE MANUFACTURERS SPECIFICATIONS BEFORE PROCEEDING TO THE NEXT TEST.



POINTS - LOW VOLTS. Permits direct reading of Point Condition. This position is also a 0-3 volt scale for checking voltage drop between various parts of the starting and electrical system.

VOLTS. Used to test the electrical and charging system. Read the 0-16 volts scale. Each division is .2 volts.

DWELL. Used to check Cam Dwell Angle. Direct reading on the 4, 6 and 8 cylinder scales.

0-1200 RPM. Read engine RPM on the 0-1200 RPM scale. Each division is 20 RPM.

0-6000 RPM. Read engine RPM on the 0-6000 RPM scale. Each division is 100 RPM.

OHMS x 1. Read OHMS directly on scale.

OHMS x 1000. Multiply OHMS scale reading by 1000.

ALTERNATOR TEST. Indicates alternator condition on GOOD-BAD scale with engine running.

OHMS CALIBRATION

The 161.21042 Automotive Analyzer uses one D cell battery and one 9 volt transistor battery to perform OHMS tests. The D cell is used on the OHMS x 1 position and both batteries are used on the OHMS x 1000 position. Both batteries are mounted in holders at the top of the cabinet in the rear compartment.

To calibrate the tester on the OHMS x 1 or OHMS x 1000 position, insert the WHITE ohms cable in the WHITE ohms socket. Temporarily touch the clips together and rotate the OHMS knob until the meter pointer is full scale at the OHMS SET line, then separate the clips. If the pointer cannot be adjusted to this line on the OHMS x 1 position, replace the D cell as shown in figure below. If the pointer cannot be adjusted to this line on the OHMS x 1000 position, replace both batteries as shown in Fig. A and B below.

BATTERY REPLACEMENT

The D cell is located in the upper left hand corner in the rear compartment. Use a good grade of standard flashlight D cell for replacement. Be sure to observe correct polarity when installing the new battery.

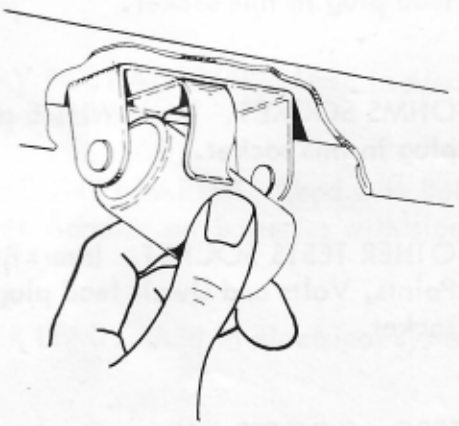


FIGURE A

The 9 volt transistor battery is located in the upper right hand corner in the rear compartment. Use any of the following types for replacement.

Sears 6417	Neda 1604
Eveready 222	Ray-O-Vac 1604

Be sure to observe correct polarity when installing the new battery.

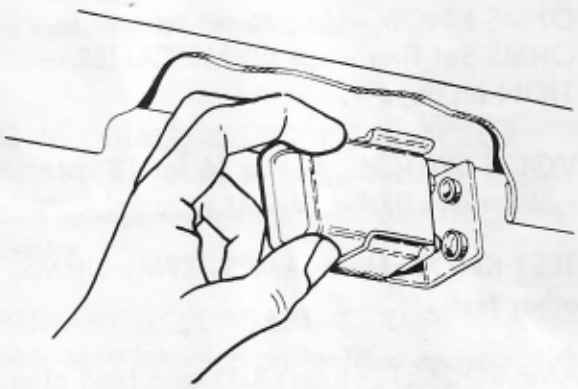


FIGURE B

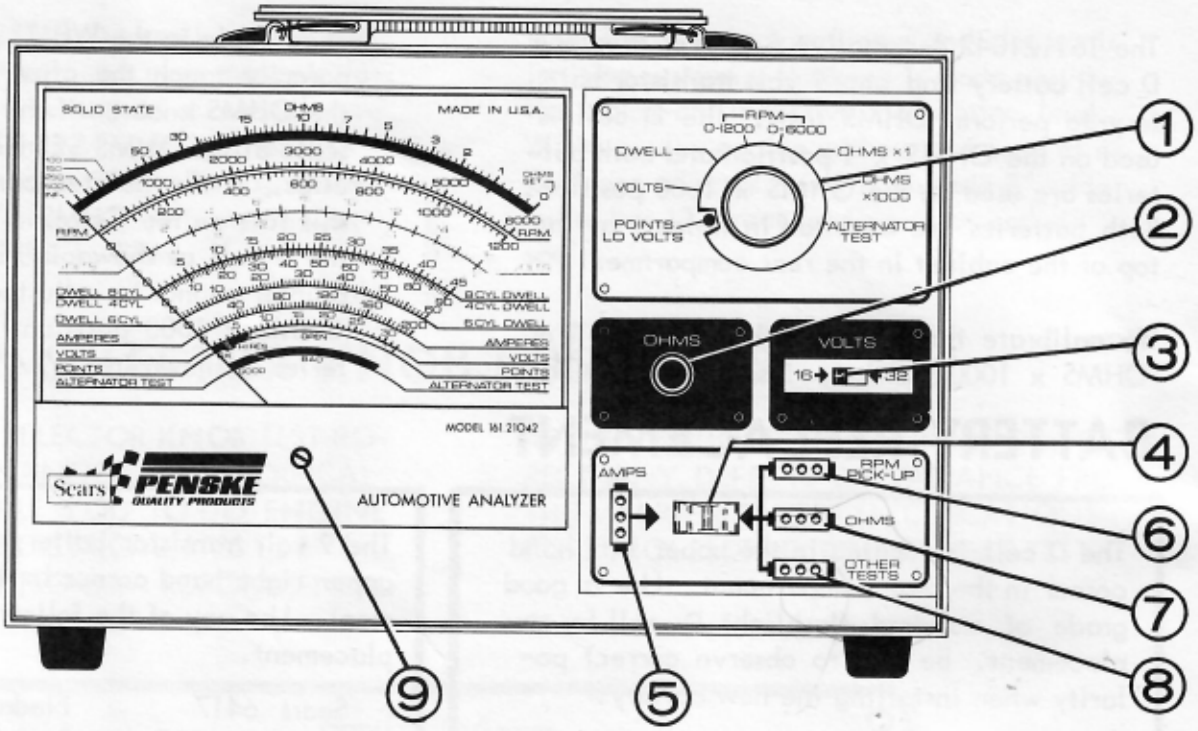
FULL 1 YEAR WARRANTY

IF, WITHIN 1 YEAR FROM THE DATE OF PURCHASE, THIS AUTOMOTIVE TEST INSTRUMENT FAILS DUE TO A DEFECT IN MATERIAL OR WORKMANSHIP, RETURN IT TO THE NEAREST SEARS STORE THROUGHOUT THE UNITED STATES, AND SEARS WILL REPAIR OR REPLACE IT, FREE OF CHARGE.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

SEARS, ROEBUCK AND CO.
BSC 41 – 3
SEARS TOWER
CHICAGO, IL 60684

CONTROLS and TEST LEAD SOCKETS



1. FUNCTION SELECTOR KNOB. A description of each position is given on page 3.

2. OHMS KNOB. Used to set pointer to OHMS Set line - see OHMS CALIBRATION on page 4.

3. VOLTS SWITCH. Set to 16 for 12 volt systems and 32 for 24 volt systems.

4. TEST KNOB selects AMPS, RPM, OHMS, other tests.

5. AMP SOCKET. Insert RED amp lead plug in this socket.

6. RPM PICK-UP SOCKET. Insert BLUE RPM lead plug in this socket.

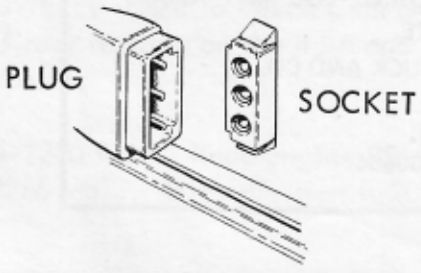
7. OHMS SOCKET. Insert WHITE ohms lead plug in this socket.

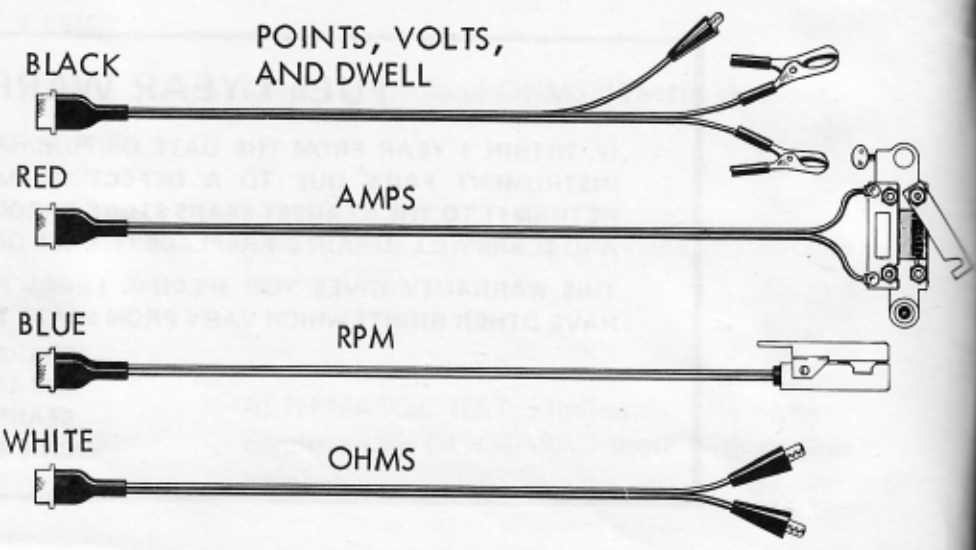
8. OTHER TESTS SOCKET. Insert BLACK Points, Volts and Dwell lead plug in this socket.

9. ZERO ADJUSTER. If meter pointer is not at zero mark, rotate zero adjuster slowly until the meter pointer is at zero.

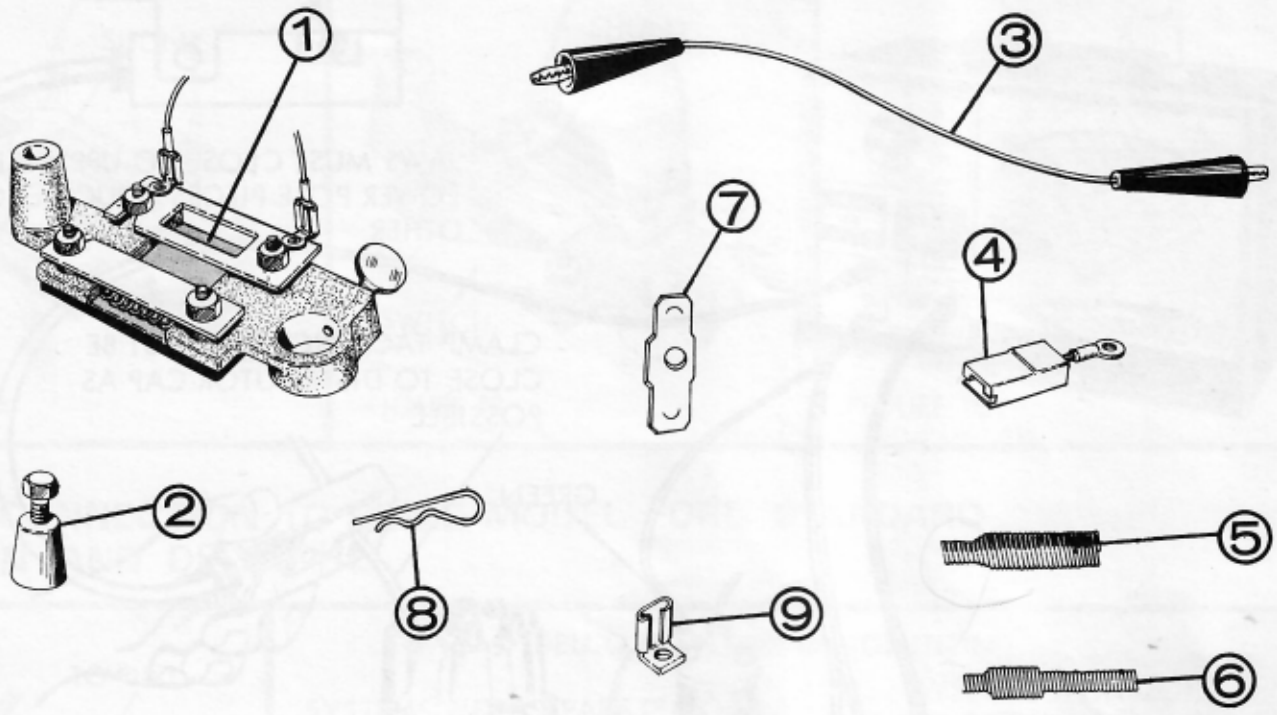
TEST LEADS

The plugs and sockets are polarized to insure correct attachment. The socket has a groove on each top corner. The plug has a mating ridge on the inside of the top corners.





ACCESSORIES



1. BATTERY POST ADAPTER. Used in electrical systems tests.

2. SIDE MOUNT ADAPTER. Used with Battery Post Adapter on batteries with side terminals.

3. JUMPER LEAD. Used in electrical systems tests.

4. PLUG CONNECTOR. Used in "A" circuit alternator output tests.

5. DOMESTIC SPARK PLUG ADAPTER. Used to make ignition cable tests.

6. FOREIGN SPARK PLUG ADAPTER. Used to make ignition cable tests.

7. G.M. DIAGNOSTIC CONNECTOR ADAPTER. Used to make tests on G.M. cars equipped with the diagnostic connector.

8. PRIMARY COIL ADAPTER. Used to provide easy hook-up on ignition systems with insulated coil primary connections.

9. H.E.I. ADAPTER. Used to provide Dwell connection on G.M. H.E.I. systems.

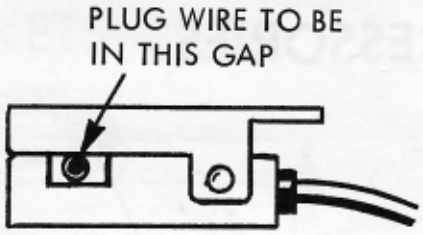
PREPARATION FOR TESTS

Before connecting the Analyzer to the vehicle, insert the BLACK, RED and BLUE test lead plugs into the appropriate sockets on the Analyzer (See page 5).

These three test leads are used for the various tune-up and electrical system tests described on pages 9 through 22 and 27 through 29.

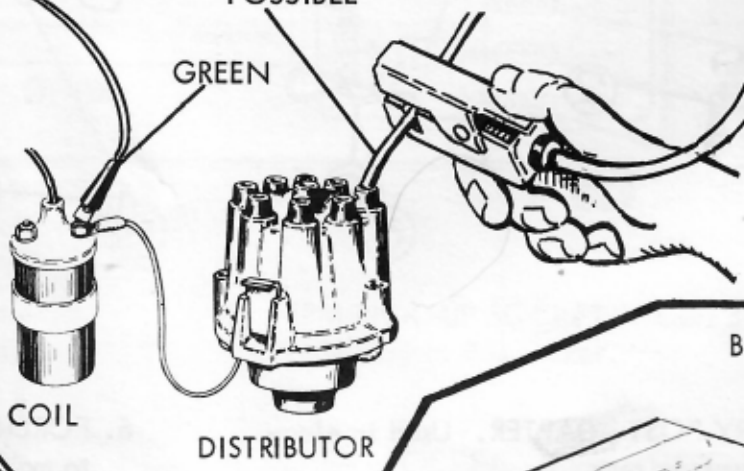
To make OHMS tests as described on pages 24, 25 and 26, insert the WHITE test lead plug into the WHITE ohms socket. For convenience in making these tests, the BLACK, RED and BLUE test leads may be removed from the Analyzer.

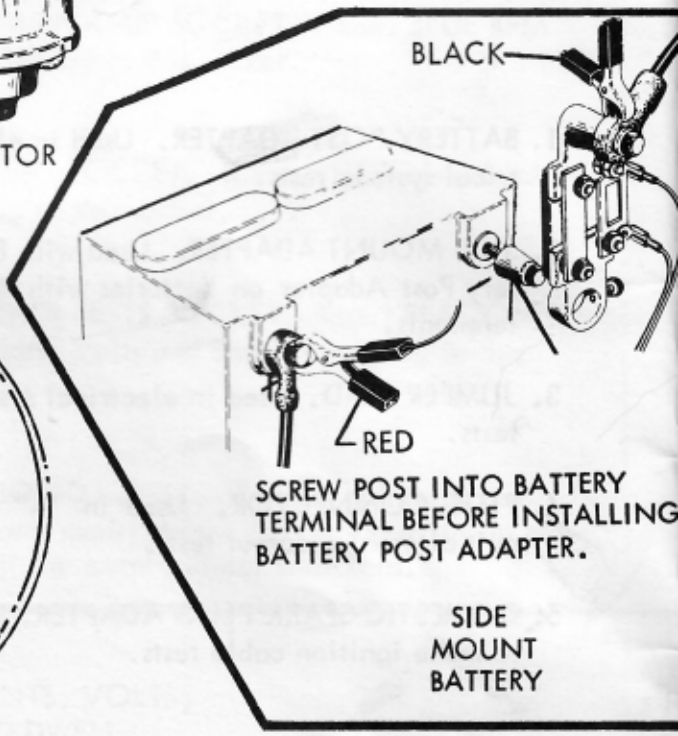
CONNECTIONS FOR TESTS



JAWS MUST CLOSE SO UPPER AND LOWER POLE PIECES TOUCH EACH OTHER

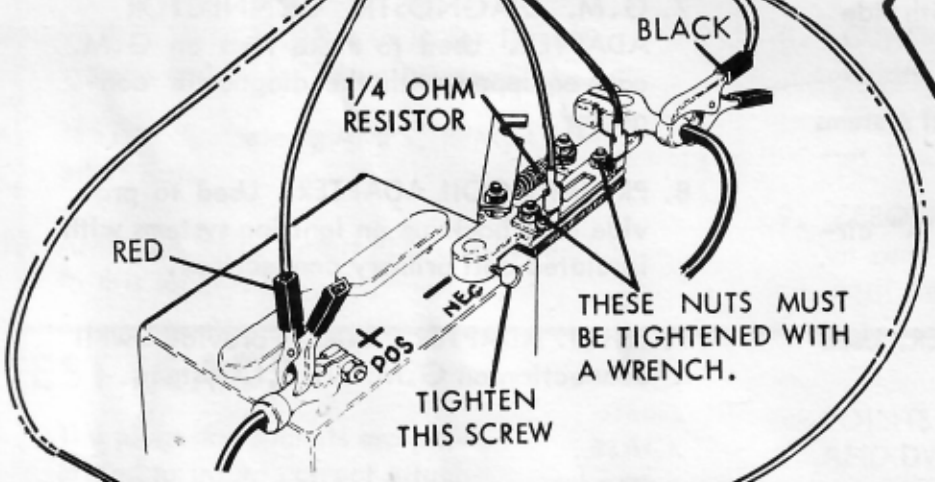
CLAMP TACH PICK-UP MUST BE CLOSE TO DISTRIBUTOR CAP AS POSSIBLE



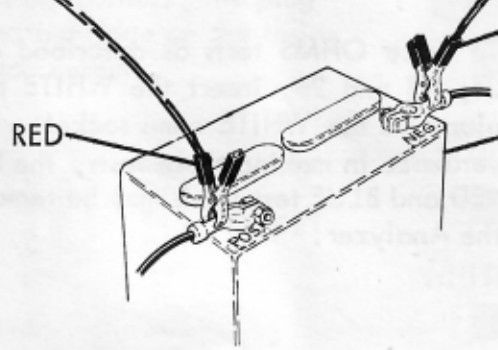


SCREW POST INTO BATTERY TERMINAL BEFORE INSTALLING BATTERY POST ADAPTER.

SIDE MOUNT BATTERY



THESE NUTS MUST BE TIGHTENED WITH A WRENCH.



IF INSTRUMENT IS USED JUST TO CHECK POINTS, VOLTS AND DWELL- CONNECT AS SHOWN TO LEFT.
BATTERY POST ADAPTOR NOT USED.

FIGURE 1

BATTERY POST ADAPTER CONNECTIONS FOR STARTING ENGINE

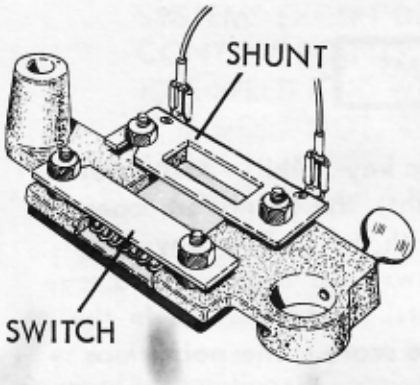


FIGURE 1A

BATTERY POST ADAPTER CONNECTIONS FOR CHARGING SYSTEMS TESTS.

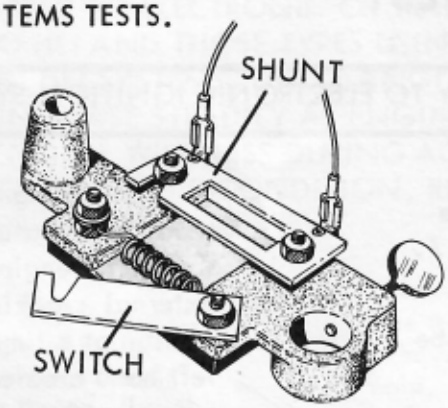


FIGURE 1B

BATTERY POST ADAPTER CONNECTIONS FOR ALTERNATOR TEST ON PAGE 19.

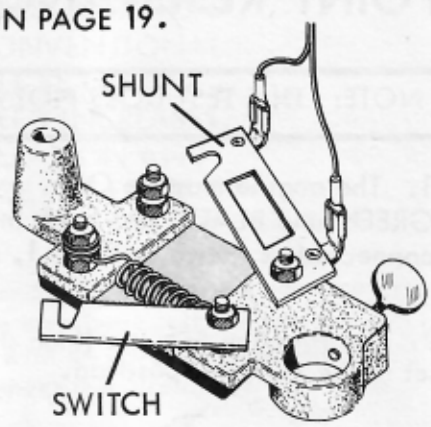
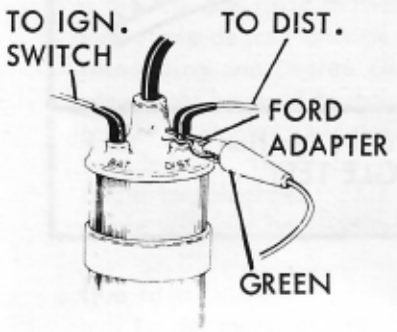


FIGURE 1C

DWELL CONNECTION TO SOME MODEL FORD STANDARD IGNITION AND DELCO HEI

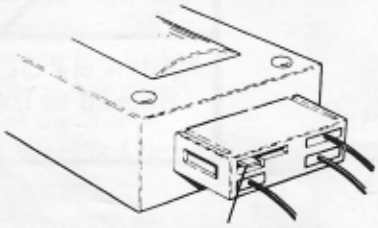


On Ford cars with insulated coil terminals, lift the distributor terminal and slide the Ford Adapter clip in place as shown, then push the terminal down on it. Remove when the tests are finished.

FIGURE 2

DELCO HIGH ENERGY IGNITION

SYSTEMS WITH SEPARATE COIL



CONNECT GREEN CLIP TO THIS TERMINAL

On engines with a separate coil, connect the GREEN clip to the open TACH terminal as indicated.

On the integral coil HEI, slide the adapter onto the TACH terminal as shown. Then connect the GREEN clip to the adapter. The RED and BLACK clips are connected to the battery Positive and Negative as shown in FIGURE 1.

SYSTEMS WITH COIL IN DISTRIBUTOR CAP

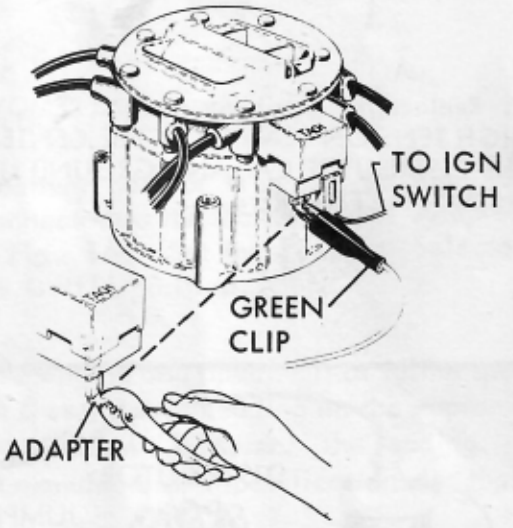
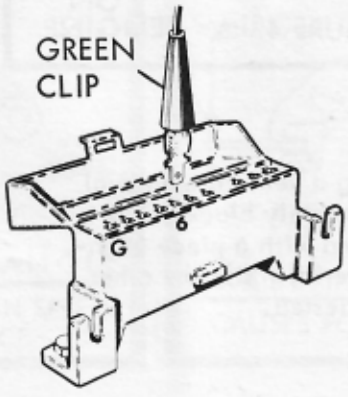


FIGURE 3

DWELL CONNECTIONS FOR GENERAL MOTORS CARS WITH DIAGNOSTIC CONNECTORS

To make Dwell tests, locate the Engine Electrical Diagnosis Connector (usually near the left front fender) open the cover and insert a spade terminal in socket No. 6.

Connect the GREEN clip to the spade terminal. The RED clip must be connected to battery POS. (+) and the BLACK clip to battery NEG. (-).



POINT RESISTANCE TEST

NOTE: THIS TEST DOES NOT APPLY TO ELECTRONIC IGNITION SYSTEMS.

1. The engine must be OFF. The GREEN and BLACK test leads must be connected as shown in FIG. 1, page 7.

2. The Function Selector Knob should be set to the POINTS position.

NOTE: Remove the distributor cap and inspect the contact points. If they are blued, blackened, or pitted, they should be replaced. Normal used contact points are light gray in color. If the contact points pass the visual inspection, proceed as follows:

3. Replace the distributor cap and REMOVE THE HIGH TENSION LEAD FROM THE CENTER OF THE DISTRIBUTOR CAP AND GROUND IT AS SHOWN IN FIGURE 4.

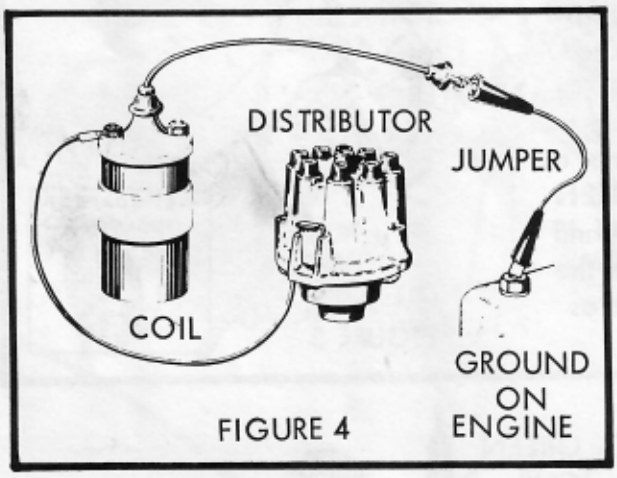
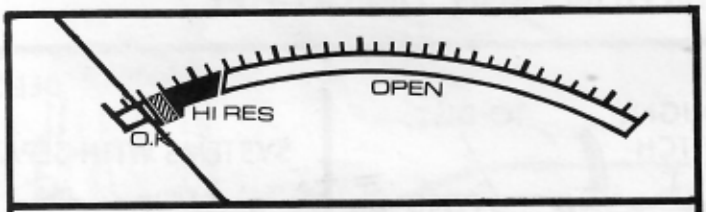


FIGURE 4

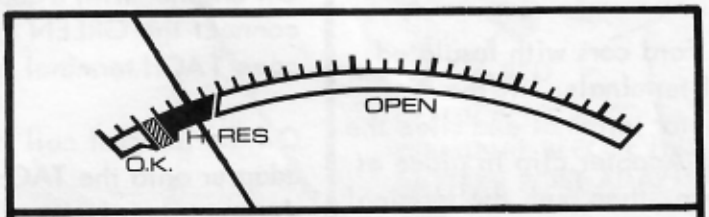
NOTE: When testing a vehicle with dual points, alternately block one set of points open with a piece of insulating material while the other set is being tested.

4. Turn the ignition key "ON". If the meter reads full scale right, the points are open. Crank the engine with the ignition key or an external cranking switch a fraction of a revolution at a time until the meter reads in the left hand area of the scale. The points are now closed.

5. TEST RESULTS



Points are GOOD. Turn the ignition key "OFF" Proceed to DWELL ANGLE TEST.



Points are defective. Check for:
Poor distributor ground.
Poor connection on the primary lead from the distributor to the ignition coil.
Defective distributor lead.
Misaligned points.

Correct the defect and repeat the test. When the points check GOOD, turn the ignition "OFF". Replace high tension lead in center of distributor cap. Proceed to DWELL ANGLE TEST.

DWELL ANGLE TEST

THIS TEST DOES NOT APPLY TO ELECTRONIC OR TRANSISTOR IGNITION SYSTEMS EXCEPT DELCO HEI AND THOSE TYPES USING CONVENTIONAL CONTACT POINTS. ON HEI SYSTEMS, DWELL ANGLE WILL BE LOW AT IDLE SPEED AND WILL INCREASE STEADILY AS ENGINE SPEED INCREASES. IF IT DOES NOT, THE ENGINE WILL MISS DURING ACCELERATION AND AT HIGH SPEEDS. TO CORRECT THIS CONDITION, REPLACE THE ELECTRONIC MODULE IN THE DISTRIBUTOR.

There is a direct relationship between dwell and timing. However, it is only a one way relationship. If you change the dwell angle of the breaker points, you will automatically change the timing of the ignition. Changing the timing, though, has no effect on the dwell angle. FOR THIS REASON, IT IS IMPORTANT TO RE-CHECK THE TIMING WHENEVER THE DWELL ANGLE HAS BEEN ADJUSTED.

When the dwell angle is increased, the timing is retarded. Conversely, when the dwell angle is decreased, the timing is advanced. In fact, there is a one-to-one ratio between dwell and timing. For every one degree change in dwell, there is a corresponding one degree change in timing. This can sometimes be used to make minor changes in timing. If, for example, it is desired to advance the timing two degrees, it can be done by reducing the dwell angle two degrees. This assumes that the dwell angle will not be changed out of its specified range.

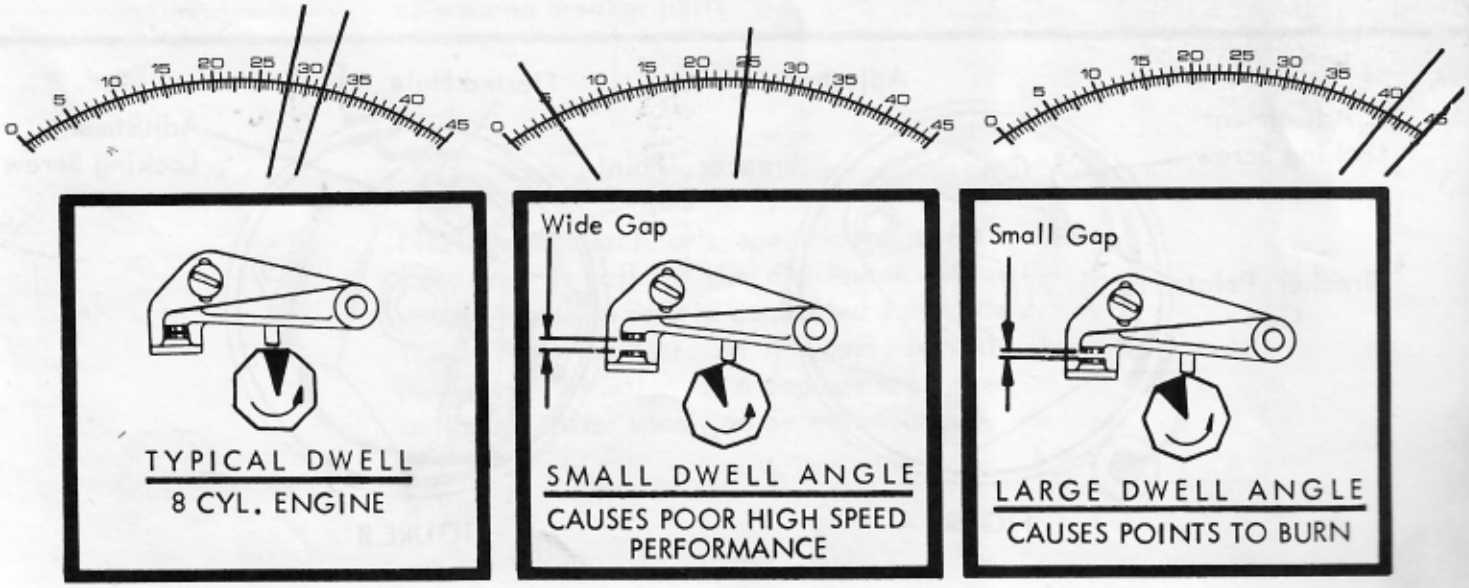
Due to normal wear of the rubbing block, the normal tendency is for the dwell angle to increase. This, of course, causes the timing to become retarded and results in a loss of power and economy. If the engine had been properly tuned initially, restoring the dwell angle to its original setting will restore the timing to its original setting.

NOTE: Disconnect and plug the vacuum advance line from the distributor. If the vehicle is equipped with an advance-retard solenoid, disconnect the wire at the carburetor end.

PLUG END OF VACUUM LINE

1. If the battery adaptor is in use, be sure the switch is connected to the Battery Amps Adapter as shown in Fig. 1A. Set the Function Selector Knob to the DWELL position.

2. Start the engine and operate it at idling speed. Observe the Dwell Angle Reading on the appropriate Dwell scale on the Meter. The reading should meet manufacturer's specifications for that engine.

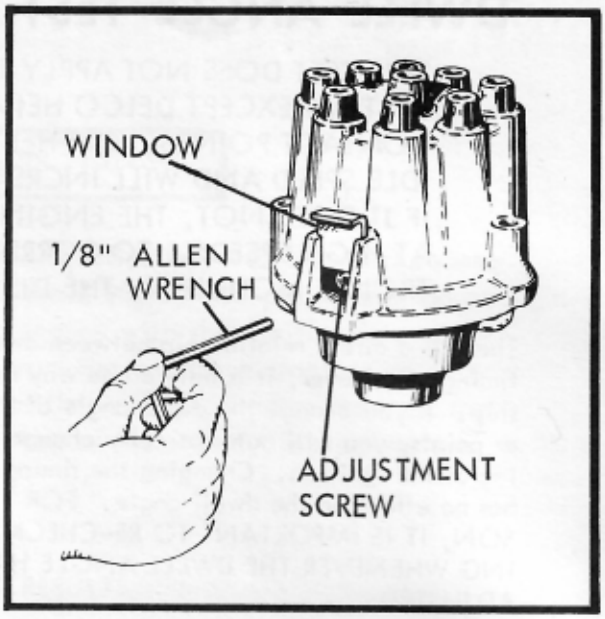


TYPICAL DWELL
8 CYL. ENGINE

SMALL DWELL ANGLE
CAUSES POOR HIGH SPEED PERFORMANCE

LARGE DWELL ANGLE
CAUSES POINTS TO BURN

DWELL ADJUSTMENT



On engines that have a sliding window in distributor cap, adjust dwell as follows:

1. Operate engine at standard idle.
2. Raise the window and insert a 1/8-Allen wrench into adjustment screw.
3. Turn adjustment screw until correct dwell is indicated on the Dwell scale.

On engines that have non-window type distributors, adjust dwell as follows:

1. Remove coil wire from center tower of distributor cap. Connect Jumper Wire between coil wire and engine ground to prevent arcing while cranking engine.
2. Remove distributor cap and rotor.
3. Connect a remote starter switch to test vehicle or have an assistant crank engine for you.
4. With ignition switch on and engine cranking, observe reading on the Dwell scale.
5. To adjust dwell, loosen locking screw slightly and adjust point gap by turning adjustment screw (Figure A) or by inserting a screwdriver in the slotted hole (Figure B) and turning the tool slightly left or right to obtain the specified gap. Tighten locking screw and recheck dwell while cranking engine. Repeat procedure if necessary.
6. Reassemble distributor and recheck dwell reading with engine operating at standard idle.

NOTE: It is important to recheck the ignition timing every time the dwell is adjusted. A one degree change in dwell causes a one degree change in timing.

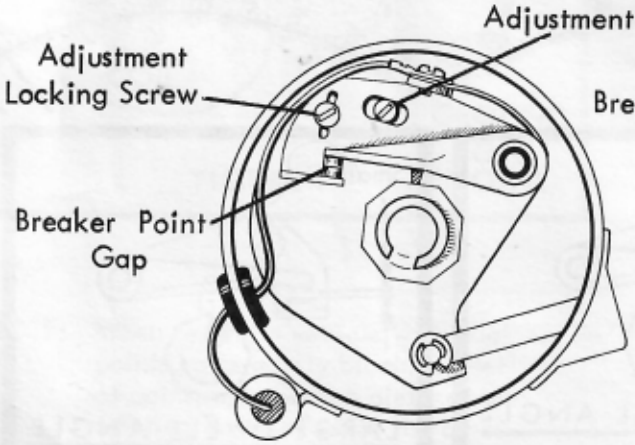


FIGURE A

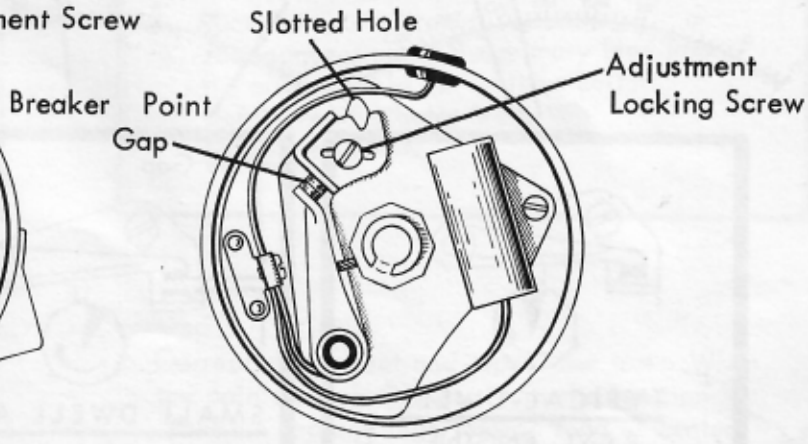


FIGURE B

DWELL VARIATION TEST

Connect Red, Black and Green test clips as shown on page 7.

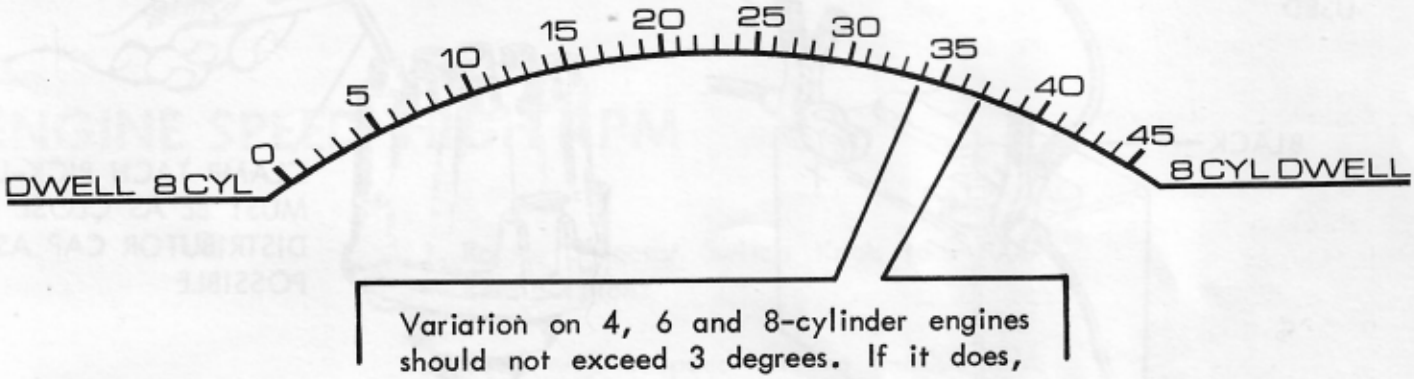
NOTE: This test does not apply to transistorized ignition systems (except those types using conventional contact points).

1. Rotate Selector Switch to DWELL position.

2. Disconnect and plug vacuum advance hose(s) as described in Dwell Angle Test on page 10.

3. Operate engine at standard idle. While observing Dwell scale for any change in reading, increase engine speed to approximately 1500 RPM and then return to idle.

4. Reconnect vacuum advance hose(s).



Variation on 4, 6 and 8-cylinder engines should not exceed 3 degrees. If it does, check for:

a. wear in distributor shaft

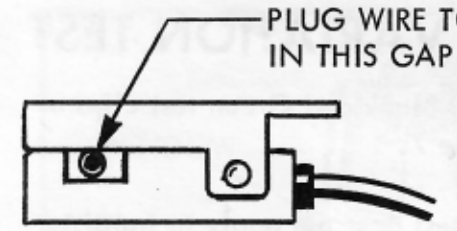
b. wear in distributor shaft bushing

c. wear in breaker plate

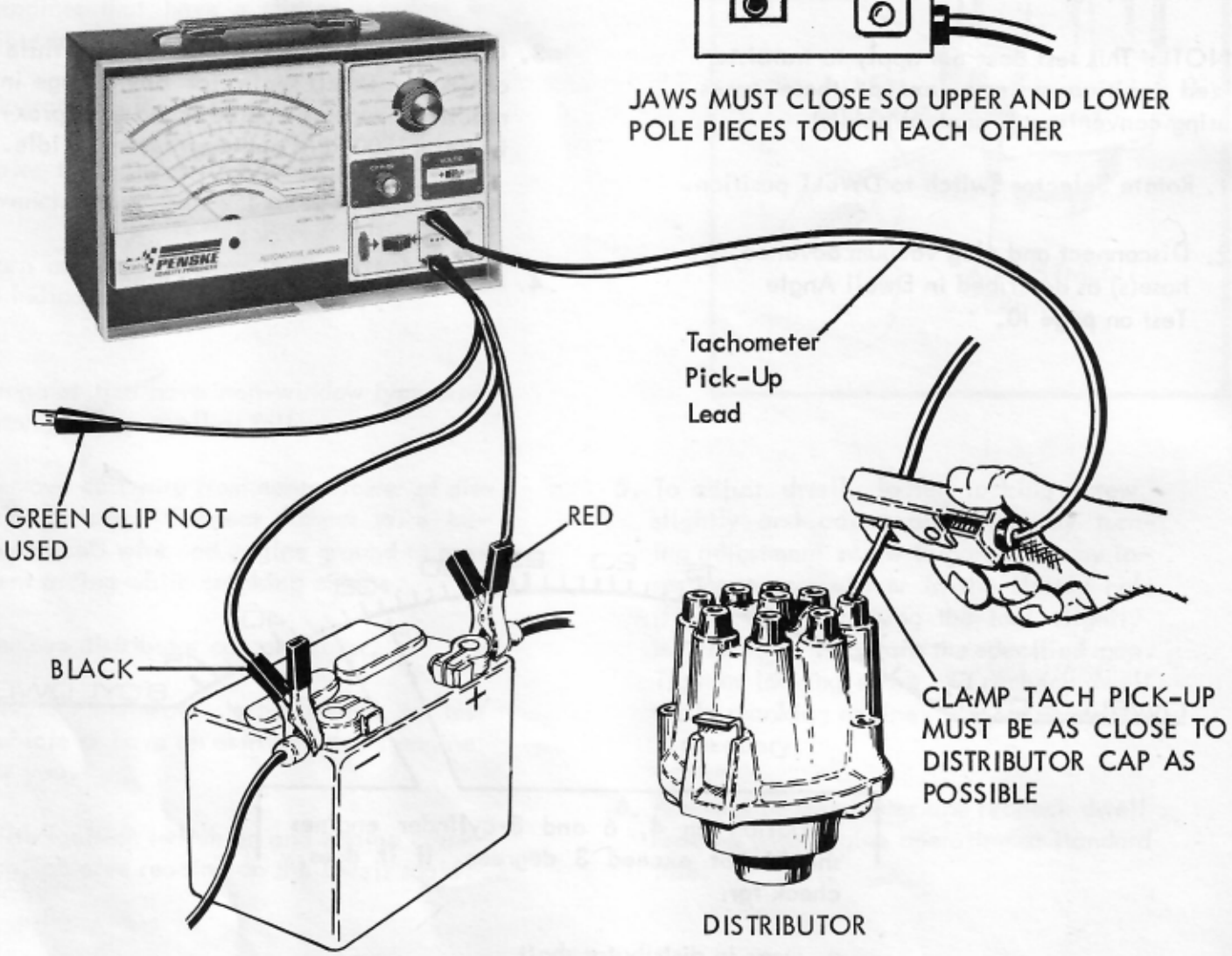
NOTE: Manufacturer's specifications for some engines call for the distributor vacuum advance hose to remain connected during the Dwell Variation Test. In this case, a maximum dwell variation of 6 degrees is allowed unless otherwise specified by manufacturer.

ENGINE SPEED TESTS

CONNECTION



JAWS MUST CLOSE SO UPPER AND LOWER POLE PIECES TOUCH EACH OTHER



1. Clamp Tachometer Pick-Up Lead onto any spark plug wire as close to the distributor as possible. Select a wire that is isolated from other spark plug cables. If the meter needle fluctuates, reverse the clamp or try another spark plug cable. Make sure that the clamp jaws are completely closed around the spark plug cable.

2. Connect Red and Black Power Lead clips to vehicle's battery, observing proper polarity (Black to negative, Red to positive-regardless of battery ground).

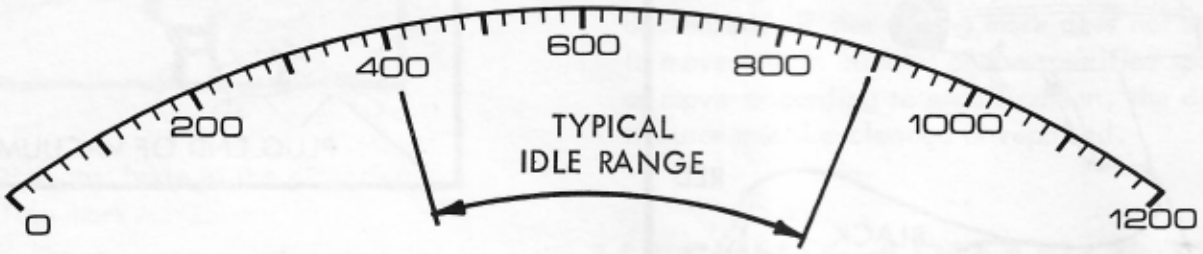
NOTE: 2-CYCLE ENGINES

2-Cycle engines produce twice as many ignition sparks as standard 4-cycle automobile engines. Thus, when testing 2-cycle engines, the indicated tachometer reading must be divided by 2 to obtain correct engine speed.

ENGINE SPEED-LOW RPM

1. Rotate Selector Switch Knob to 0-1200 RPM position.

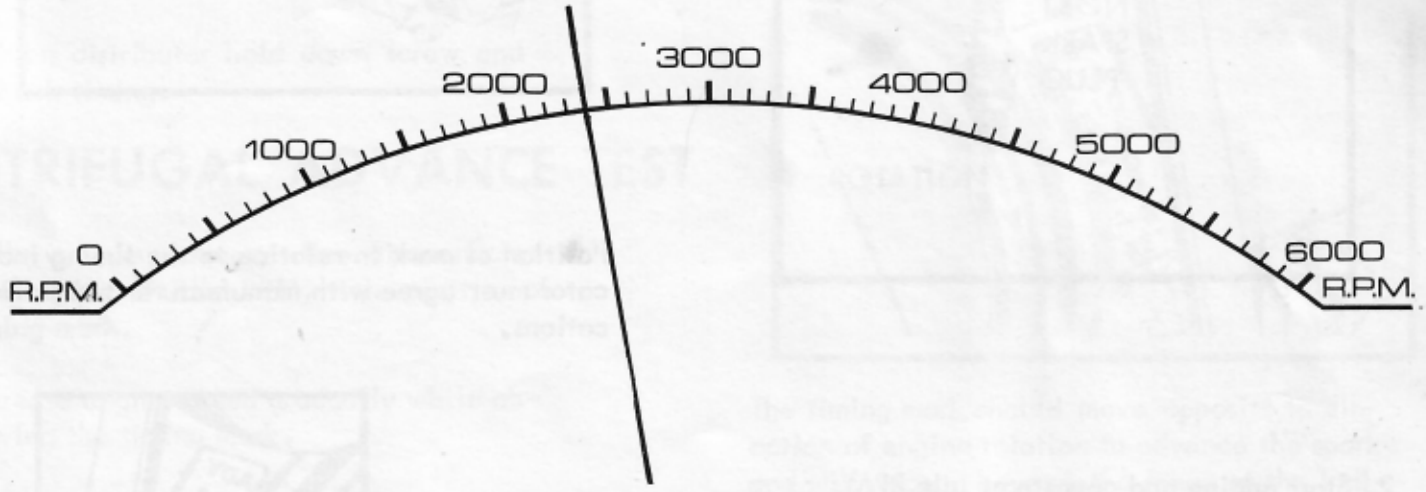
2. Read engine speed on the 0-1200 RPM scale.



ENGINE SPEED-HIGH RPM

1. Rotate Selector Switch Knob to 0-6000 RPM position.

2. Read engine speed on the 0-6000 RPM scale.

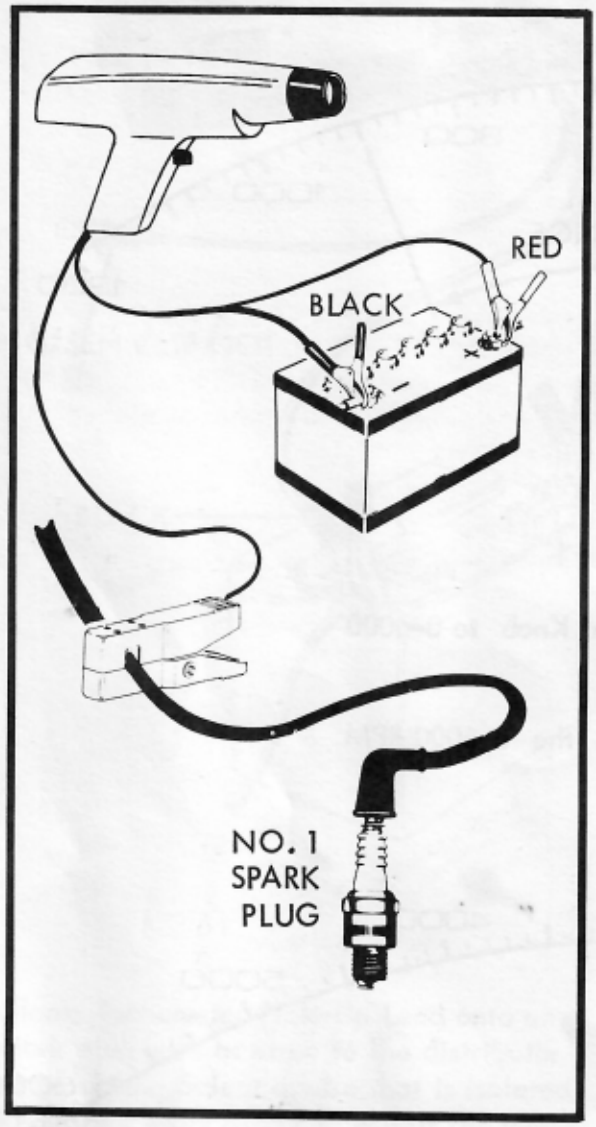


The 0-6000 RPM scale is used primarily for setting the engine at specified speeds to perform other tests. It can also be used for road testing purposes.

TIMING LIGHT TESTING

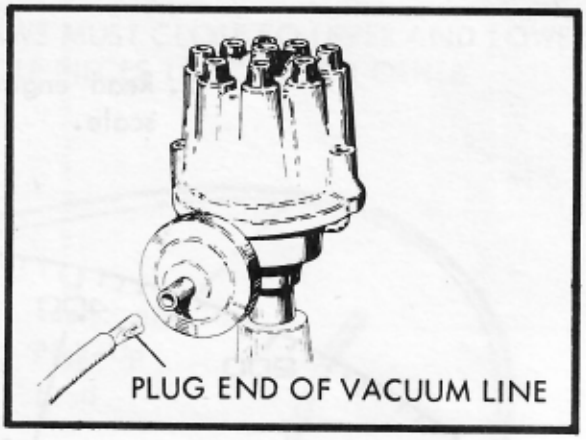
INITIAL TIMING TEST

1. Connect timing light leads to the proper power source and the No. 1 spark plug in the firing order as shown.

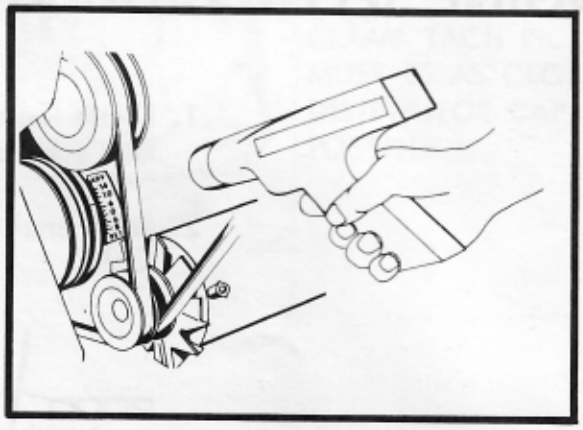


2. Start engine and operate at idle RPM.

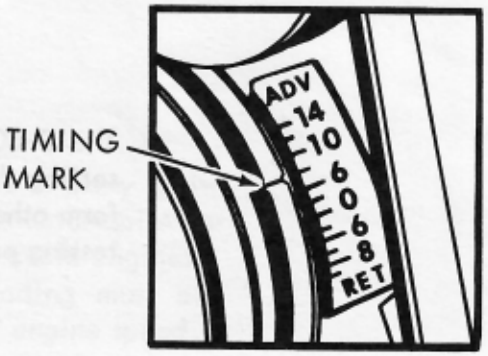
3. Disconnect and plug vacuum advance line to the distributor.



4. Press switch on timing light and observe timing mark.

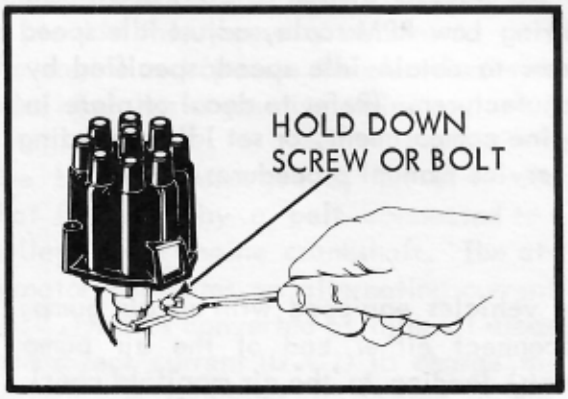


Position of mark in relation to the timing indicator must agree with manufacturer's specifications.

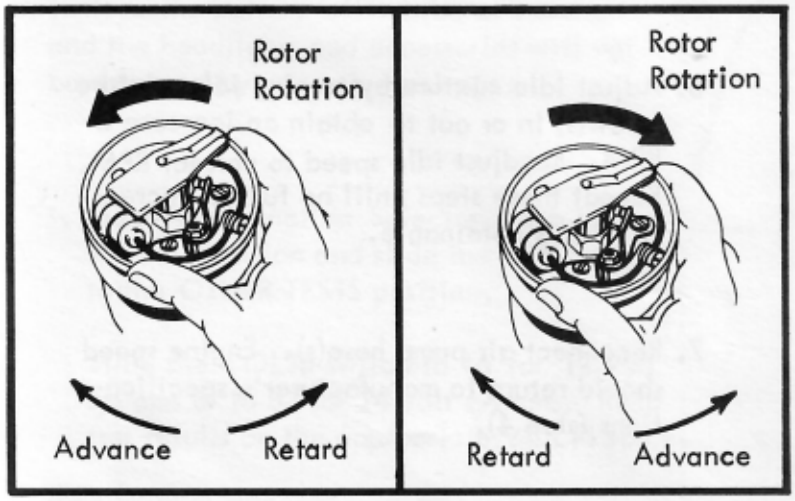


TIMING ADJUSTMENT

1. To change the timing of the engine, loosen distributor hold down screw or bolt.



2. Rotate the distributor body in the direction required to align mark.



3. Tighten distributor hold down screw and recheck timing.

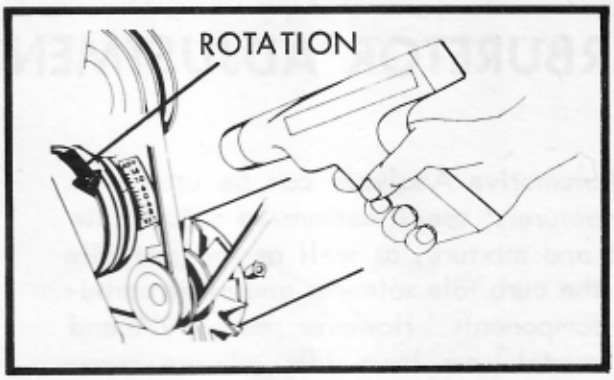
CENTRIFUGAL ADVANCE TEST

1. With vacuum advance line disconnected and engine at idle RPM, note position of timing mark.

2. Increase engine speed gradually while observing the timing mark.

TEST RESULTS

The timing mark should move steadily and without jerking, opposite to the direction of rotation, as the engine speed is increased to about 1800 RPM. Then, the timing mark



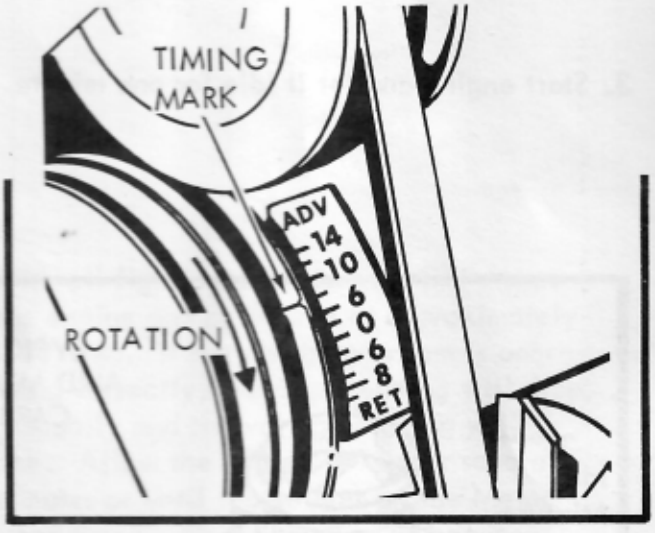
should move back smoothly as the speed is decreased. If the timing mark does not start to move within 50 RPM of the specified speed or move according to specification, the distributor must be cleaned or repaired.

VACUUM ADVANCE TEST

1. Operate engine at approximately 1500 RPM.

2. Reconnect vacuum advance line to distributor and observe timing change.

TEST RESULTS



The timing mark should move opposite to direction of engine rotation to advance the spark, and will appear beyond the range of the indicator.

NOTE: On vehicles equipped with certain emission control systems, there will be no vacuum advance when performing this test. Check manufacturer's test procedure.

CARBURETOR ADJUSTMENT

The Automotive Analyzer can be used with manufacturers' specifications to adjust idle speed and mixture, as well as the fast idle cam, the curb idle solenoid and other carburetor components. However, many 1970 and later model cars have idle mixture screw limiter caps that prohibit or restrict carburetor adjustment. On vehicles so equipped, the carburetor should be adjusted according to the manufacturer's service manual procedures.

Carburetors without mixture screw limiter caps can be adjusted as follows:

1. Start engine and allow it to warm to normal operating temperature. Shut off engine.

2. Turn in idle mixture screw(s) until it/they are lightly seated. Back screw(s) out three full turns.

3. Start engine and let it idle for one minute.

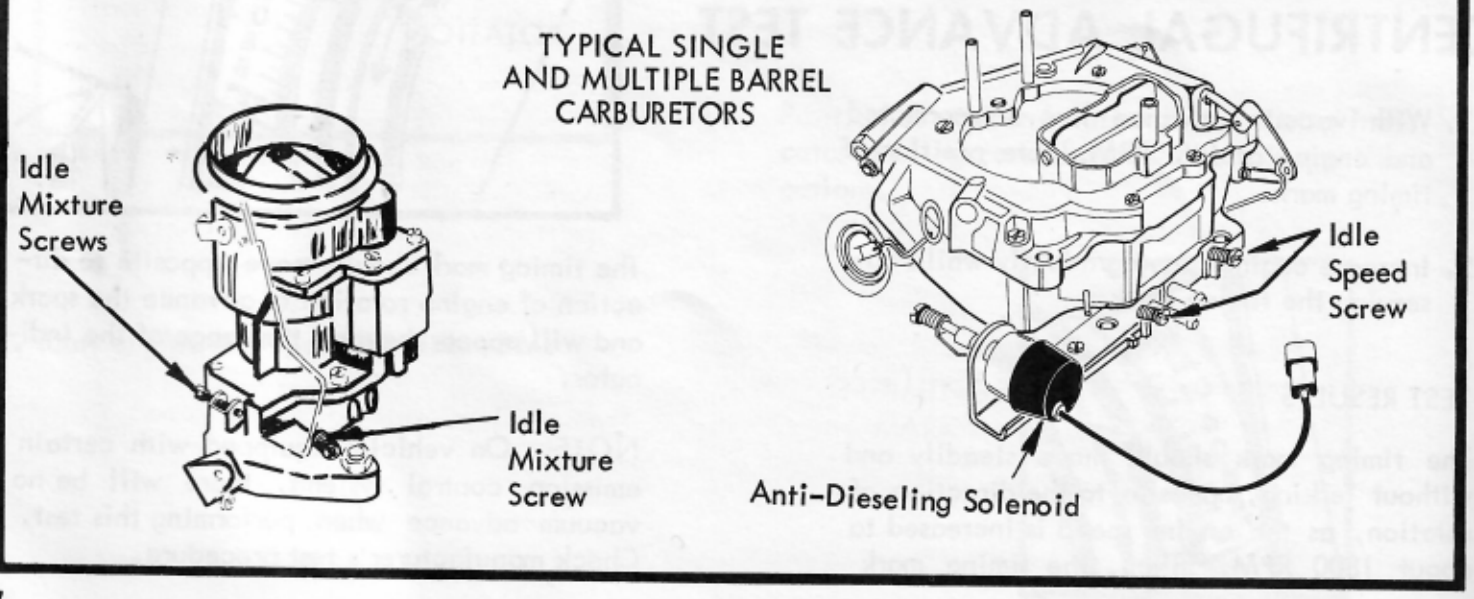
4. Rotate Selector Switch to LOW RPM. Observing Low RPM scale, adjust idle speed screw to obtain idle speed specified by manufacturer. (Refer to decal or plate in engine compartment, or set idle according to service manual procedures).

5. On vehicles equipped with an air pump, disconnect either end of the air pump hose(s) leading to the air manifold check valve. Note that the engine speed drops. This lowered engine speed is the RPM that must be maintained during idle mixture adjustment.

6. Adjust idle mixture by turning idle mixture screw(s) in or out to obtain an increase in RPM. Readjust idle speed to correct RPM. Repeat these steps until no further increase in RPM is obtainable.

7. Reconnect air pump hose(s). Engine speed should return to manufacturer's specifications (step 4).

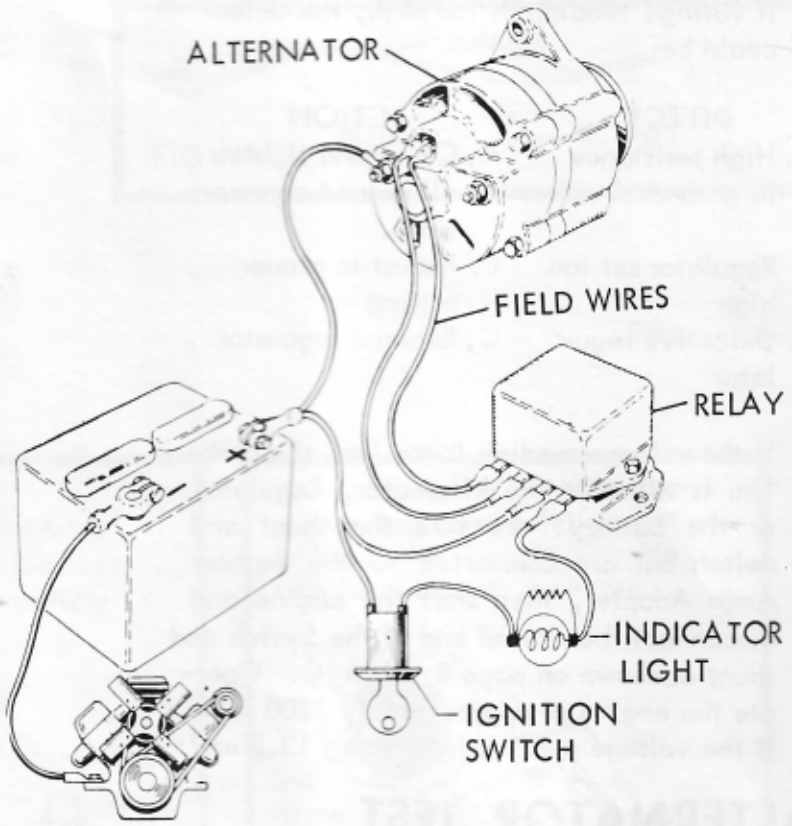
TYPICAL SINGLE AND MULTIPLE BARREL CARBURETORS



CHARGING SYSTEM VOLTS TEST

The function of the charging system is to keep the battery in a state of charge and to provide the necessary current to start the engine and operate the electrical systems when the engine is running.

The battery is charged by an alternator that is driven by a belt connected to a pulley on the engine crankshaft. The alternator generates an alternating current (A.C.) that is converted by internal diodes into direct current (D.C.) to charge the battery. A regulator is needed in the charging system because the alternator output voltage increases as the engine speed increases. The regulator keeps the alternator output voltage at a safe upper limit so the battery will not be overcharged and the headlights and accessories will not be damaged by excessive voltage.



TYPICAL ALTERNATOR CHARGING SYSTEM

1. Place the Function Selector Knob in the VOLTS position and slide the TESTS knob to the OTHER TESTS position.

   Slide the VOLTS switch to 16 for 12 volt systems or to 32 for 24 volt systems. Read test results on the appropriate VOLTS scale.

2. Be sure the switch and shunt are in position on the Battery Amps Adapter as shown in Fig. 1A, page 8.
   CAUTION: TIGHTEN NUTS FIRMLY WITH WRENCH TO AVOID EXCESSIVE HEAT AND POSSIBLE SHUNT DAMAGE.
   Start the engine and allow it to run for 10 or 15 minutes or until the engine compartment is warm, then shut it off.

3. THIS STEP IS IMPORTANT. In order to get proper results from this test, the battery must be partially discharged.
   To accomplish this, switch on the headlights and put the blower on HIGH for a minimum of one minute.

4. With all lights and accessories OFF, start the engine and operate it at approximately 1500 RPM. If the charging system is operating correctly, the amps reading will drop gradually and the voltage reading will rise. Allow the engine to run for several minutes or until the pointer on the Meter stops rising. If the reading is between 13.8 and 15.4 on 12 volt systems or 27.6 and 30.8 on 24 volt systems, the alternator output voltage is O.K. Proceed to Alternator Output Test on page 20. If the voltage readings are incorrect, proceed to Step 5.

ON DELCO INTEGRAL CHARGING SYSTEMS ELIMINATE STEPS 5, 6, AND 7.

5. If voltage reading is too high, the defect could be:

DEFECT	ACTION
A. High resistance in ground circuit	A. Clean and tighten all ground connections.
B. Regulator set too high	B. Adjust to proper setting
C. Defective regulator	C. Replace regulator

6. If the voltage reading is too low, the problem is either in the Alternator, Regulator or the battery. Be sure the shunt and switch bar are connected to the Battery Amps Adapter, then start the engine and disconnect the slotted end of the Switch and shunt as shown on page 8, Fig. 1C. Operate the engine at approximately 1200 RPM. If the voltage reading is between 13.8 and 15.2 on 12 volt systems and 27.6 and 30.4 on 24 volt systems, the regulator is O.K. If the voltage reading is still low, adjust or replace the regulator.

   If the voltage is still low, proceed to Alternator Test. If Alternator Tests indicates that the alternator is O.K., proceed to Step 7.

7. After Step 6 is completed, the alternator and regulator will be functioning satisfactorily, leaving the battery as the only untested part of the charging system. To test the battery condition, attach the shunt to the Battery Amps Adapter as shown in Fig. 1A, page 8, and start the engine, and operate it at approximately 1200 RPM. If the voltage reading is less than 13.8 check the water level in the battery and fill to the proper level if necessary. Then charge the battery and repeat this test. If the voltage reading is still low, the battery is bad and should be replaced.

ALTERNATOR TEST

1. Place the Function Selector Knob in the ALTERNATOR TEST Position.

2. Be SURE the shunt and switch bar are connected on the Battery Amps Adapter as shown in Fig. 1A, page 8, CAUTION: TIGHTEN NUTS FIRMLY WITH WRENCH TO AVOID EXCESSIVE HEAT AND POSSIBLE SHUNT DAMAGE. IF YOU ATTEMPT TO START THE ENGINE WITH THE SHUNT DISCONNECTED, THE 1/4 OHM RESISTOR MAY BLOW OUT.

3. Start the engine, then open the switch and shunt as shown in Fig. 1C, page 8. Turn the headlights on and operate the engine at approximately 1200 RPM and observe the alternator condition.

4. A reading in the green GOOD zone on the Meter indicates that the alternator windings and diodes are O.K.

5. A reading in the red BAD zone indicates that one or more diodes are open or shorted or that the stator winding is open or shorted to ground or has shorted turns. Have the alternator serviced or replaced.

ALTERNATOR OUTPUT TEST

This test will enable you to check the alternator output current (Amps).

In order to perform the test, it is necessary to ground the field in Type A CIRCUIT or remove the regulator from the charging system and energize the field in Type B CIRCUIT.

Illustrated in Fig. 5 are the jumper and plug provided for this purpose.

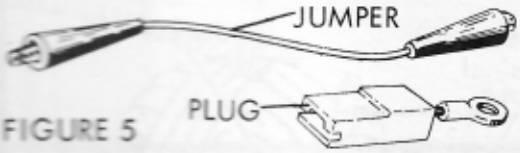
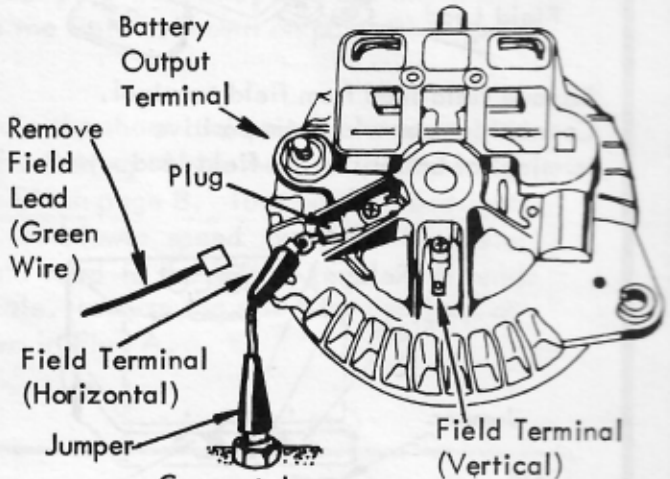


FIGURE 5

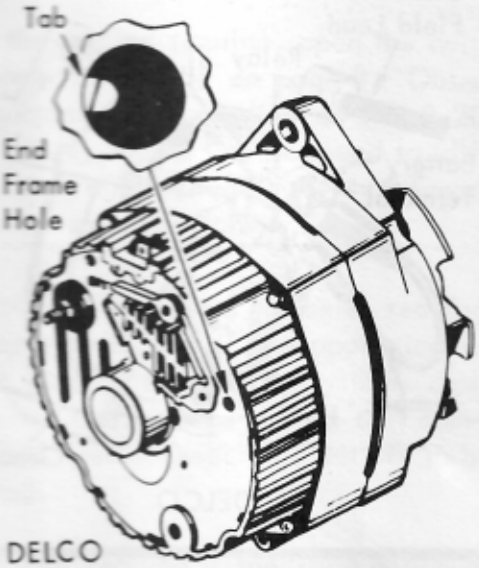
"A" CIRCUIT (Electronic Voltage Regulator)

CHRYSLER

Remove field lead (green wire) from the alternator field terminal. Connect jumper wire from the alternator field terminal to ground.

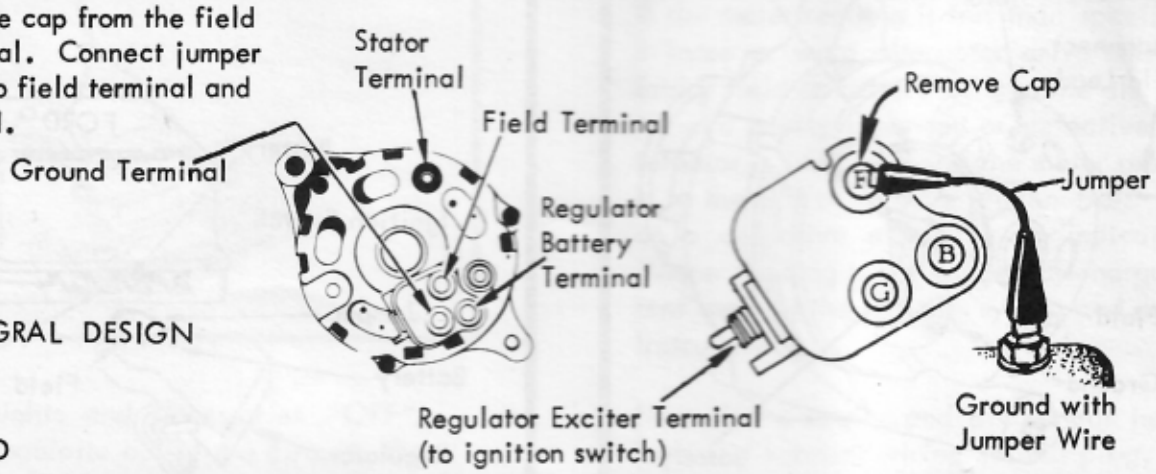


Insert screwdriver not more than 1 inch in end frame hole, ground tab to frame with screwdriver. No additional adapter is needed.



DELCO

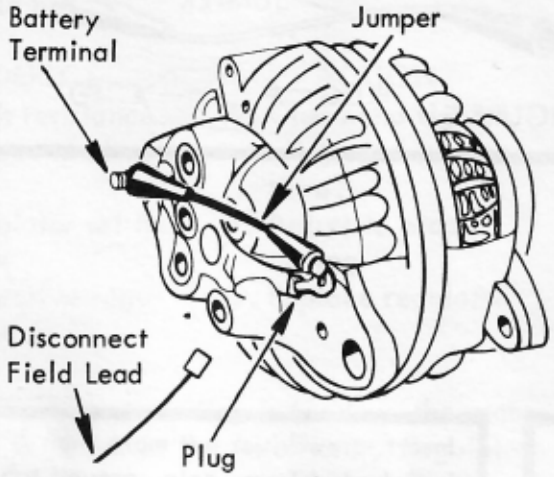
Remove cap from the field terminal. Connect jumper wire to field terminal and ground.



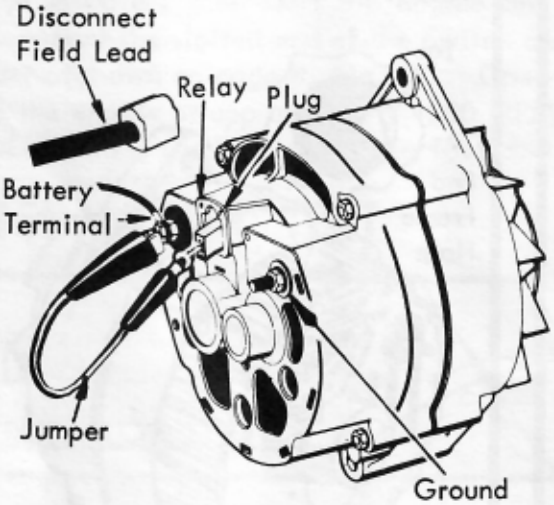
INTEGRAL DESIGN

FORD

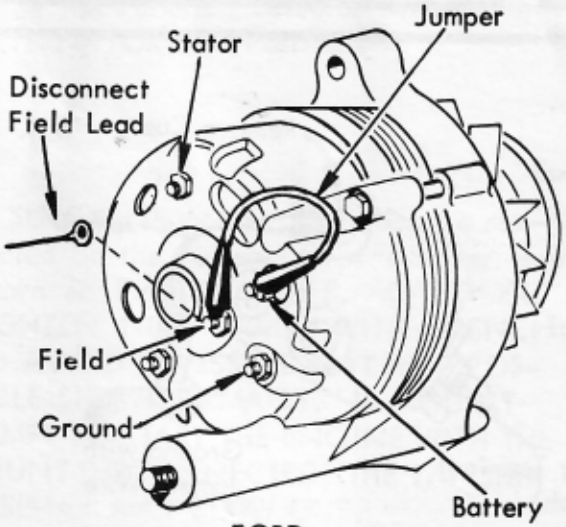
"B" CIRCUIT (External Voltage Regulator)



CHRYSLER

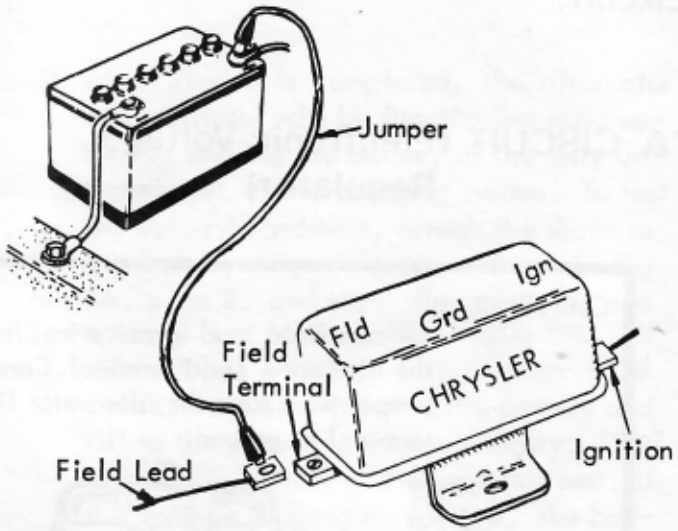


DELCO

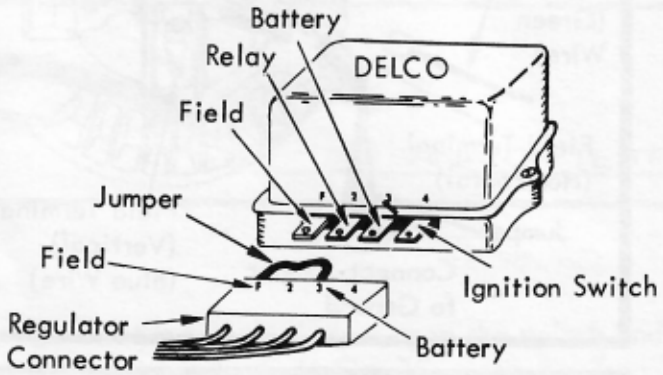


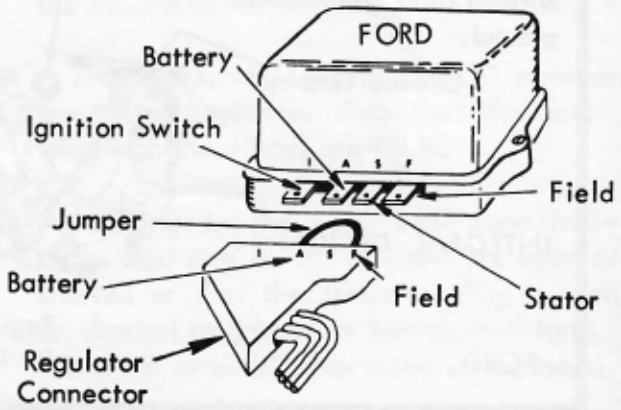
FORD

On some vehicles it may be inconvenient to connect the jumper wire at the alternator. In such a situation remove the regulator connector from the voltage regulator and connect a jumper wire as illustrated.

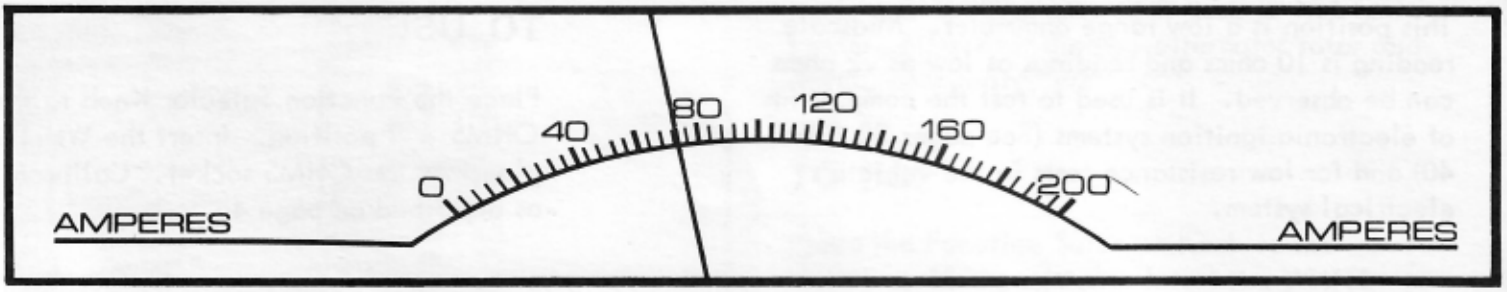


Remove field lead from field terminal. Connect jumper wire from positive terminal of battery to the field lead.





ALTERNATOR OUTPUT TEST (CONT.)



1. Place the Function Selector Knob in the VOLTS position and slide the TESTS knob to the AMPS position.

2. On Type A CIRCUIT, ground the field as shown on page 20 and proceed with Step 4.

3. On Type B CIRCUIT, disconnect the wiring harness plug from the regulator and energize the field as shown on page 21.

4. Be sure the shunt and switch are connected to the Battery Amps Adapter as shown in Fig. 1A on page 8. Turn on the headlights and set blower speed to high. The meter should read to the left of zero. If it reads upscale, reverse the shunt connections as shown in Fig. A.

Caution: DO NOT pull on the wires. If necessary, grasp the terminal with pliers to remove it.

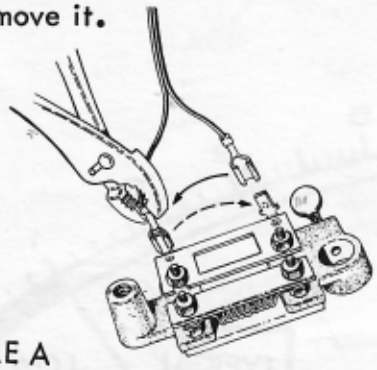


FIGURE A

Turn all lights and accessories "OFF". With the regulator out of the circuit, the alternator output voltage may be high enough to burn out lights or damage accessories. Start the engine and operate it at the speed recommended by the manufacturer for alternator output test. Unless otherwise specified, adjust engine speed as follows:

Chrysler,	1250 RPM
GM-Delco-Remy,	2500 RPM
Ford	2900 RPM

With the engine running, open the switch as shown in Fig. 1B on page 8. Observe the current (amps) reading on the 0-200 Amps scale, reduce engine speed to idling and compare meter reading with the manufacturer's specifications.

NOTE: Add 5 amperes to meter reading for output test. This is the approximate current used by the ignition system, dash instruments and alternator field coil combined and does not reach the battery to be measured.

If the meter reading is specified minimum or higher, alternator output is satisfactory. If the meter reading is less than specified, a loose or worn alternator drive belt, a faulty field or battery wire to the alternator or a poorly grounded or defective alternator is indicated. If the meter reading is to the left of zero, a broken field wire or a defective alternator is indicated. (Meter reading is the battery discharge current used by the ignition system and dash instruments).

5. Shut off the engine and disconnect jumper lead and connect wiring harness plug, connector or field wire to regulator.

OHMS x 1 POSITION

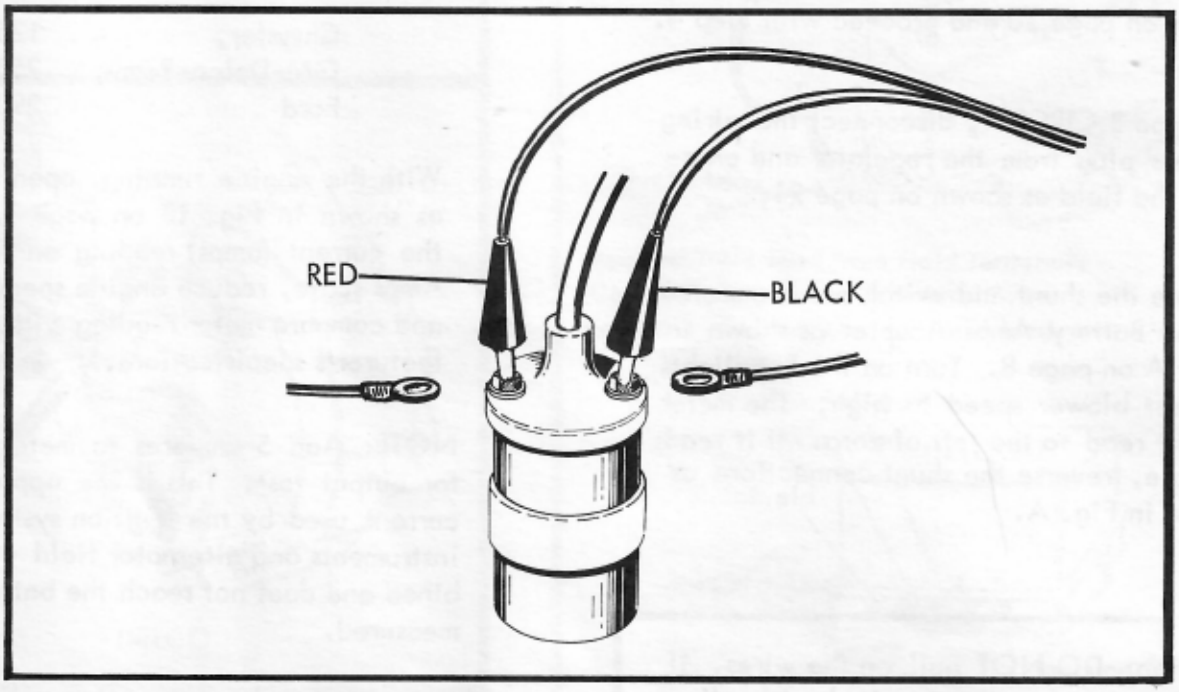
This position is a low range ohmmeter. Midscale reading is 10 ohms and readings as low as .2 ohms can be observed. It is used to test the components of electronic ignition systems (See pages 30 thru 40) and for low resistance tests in the vehicle's electrical system.

TO USE

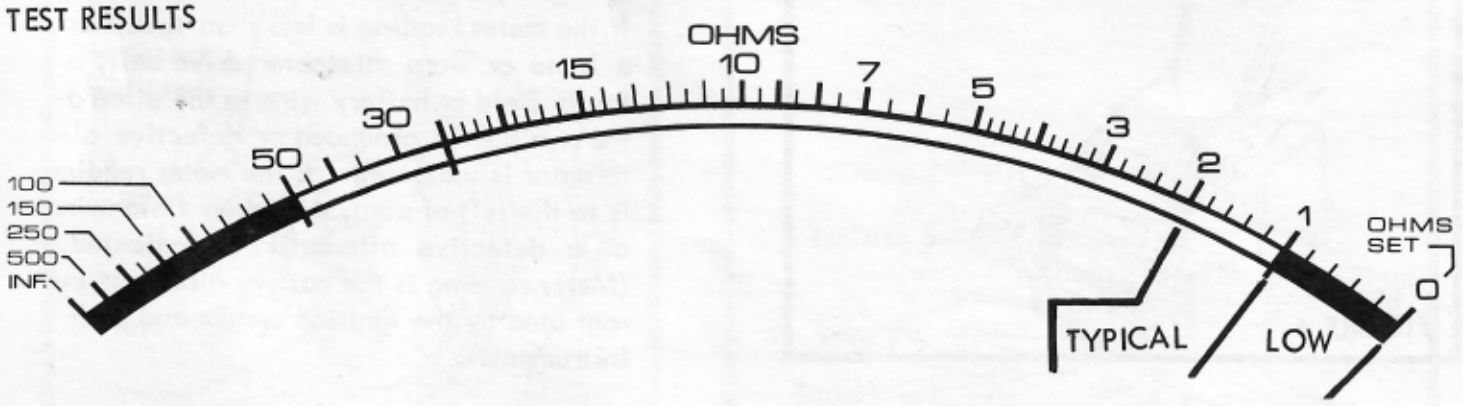
Place the Function Selector Knob to the OHMS x 1 position. Insert the WHITE plug into the OHMS socket. Calibrate as described on page 4.

IGNITION COIL PRIMARY RESISTANCE TEST

1. Set the Selector Knob to the OHMS x 1 position and calibrate as described above.
2. Remove primary wires from both coil terminals.
3. Connect Red and Black test leads to primary coil terminals, as illustrated.
4. Observe reading on the Low Ohms scale, then re-connect primary wires.



TEST RESULTS



A. Reading should meet vehicle manufacturer's specifications. Generally, coil primary winding resistance should be between 1 and 2 ohms.

B. If reading is substantially above or below manufacturer's specifications, ignition coil is defective.

OHMS x1000 POSITION

This position is a high range ohmmeter. Midscale reading is 10000 ohms. It is used to test ignition cables, alternator diodes, alternator rotor and stator, continuity, etc.

TO USE

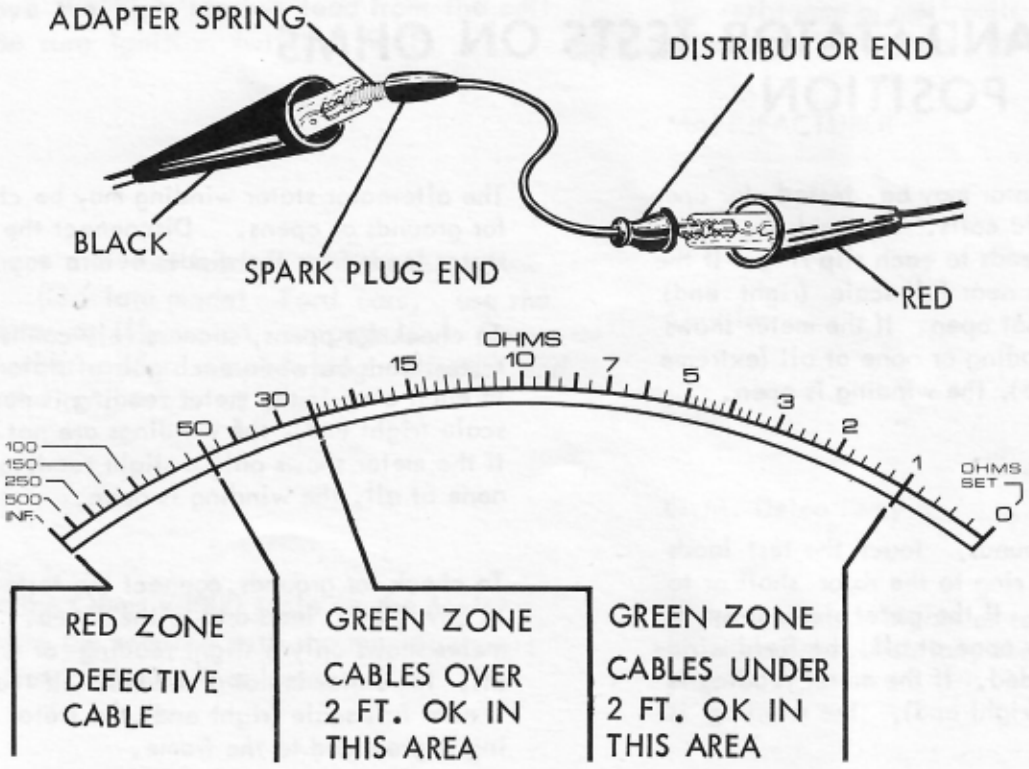
Place the Function Selector Knob to the OHMS x 1000 position. Insert the WHITE Plug into the OHMS socket. Calibrate as described on page 4.

IGNITION CABLE TEST

Ignition cable is NOT solid wire. It is a special graphite impregnated fibre conductor with a built-in resistance of 1000 to 50,000 ohms, depending upon the length of the cable and the type of engine. This resistance is necessary to suppress spark interference with radio, television and other communication reception. It also contributes to longer distributor cap and spark plug electrode life. If the resistance value of the cable is significantly increased by stretching or breaking the internal graphite impregnated conductor, the engine will misfire and its overall performance will deteriorate.

1. Remove the cables from the engine. When removing the wire from the spark plug, grasp the spark plug boot and twist and pull with a firm, steady force. DO NOT yank on the cable to remove it.

2. Then connect the RED and BLACK test leads to the ends of the cable as shown below, use adapter spring AT SPARK PLUG END OF CABLE as shown. See illustration below left for readings.



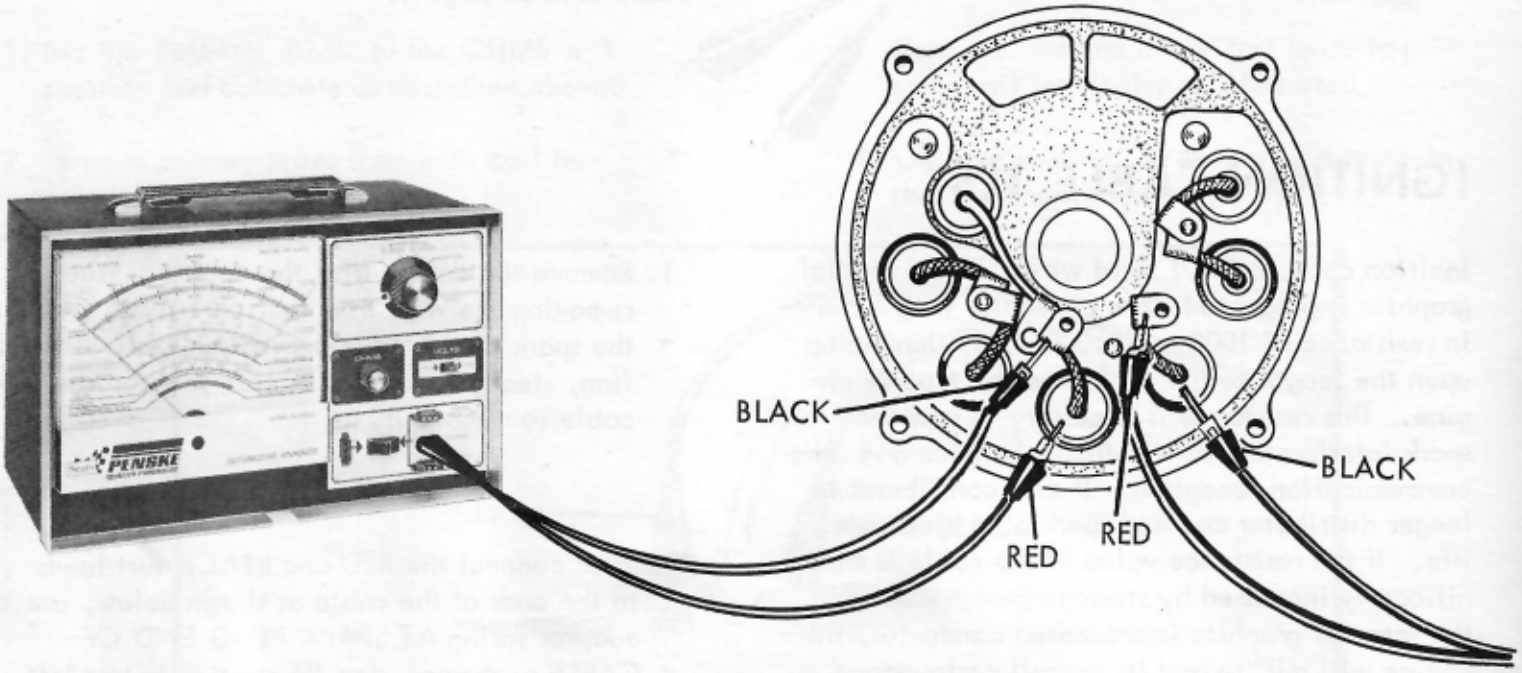
DIODE TESTS ON OHMS x1000 POSITION

Alternator diodes in a disassembled alternator can be tested for "shorts" or "opens" with the stator leads disconnected as illustrated.

To facilitate checking the diodes in the end frame and heat sink, place a short length of wire or nail in the jaws of the RED and BLACK test clip as shown in the illustration.

Then touch the wire lead to the diode case and diode lead as illustrated and note the meter reading. Then reverse the lead connections and again note the reading.

A good diode will have one low and one high reading. If both readings are very low, or if both readings are very high, the diode is defective.



ROTOR AND STATOR TESTS ON OHMS x 1000 POSITION

The alternator rotor may be tested for open or grounded field coils. To check for opens, touch the test leads to each slip ring. If the meter reading is near full scale (right end) the winding is not open. If the meter shows only a slight reading or none at all (extreme left end of scale), the winding is open.

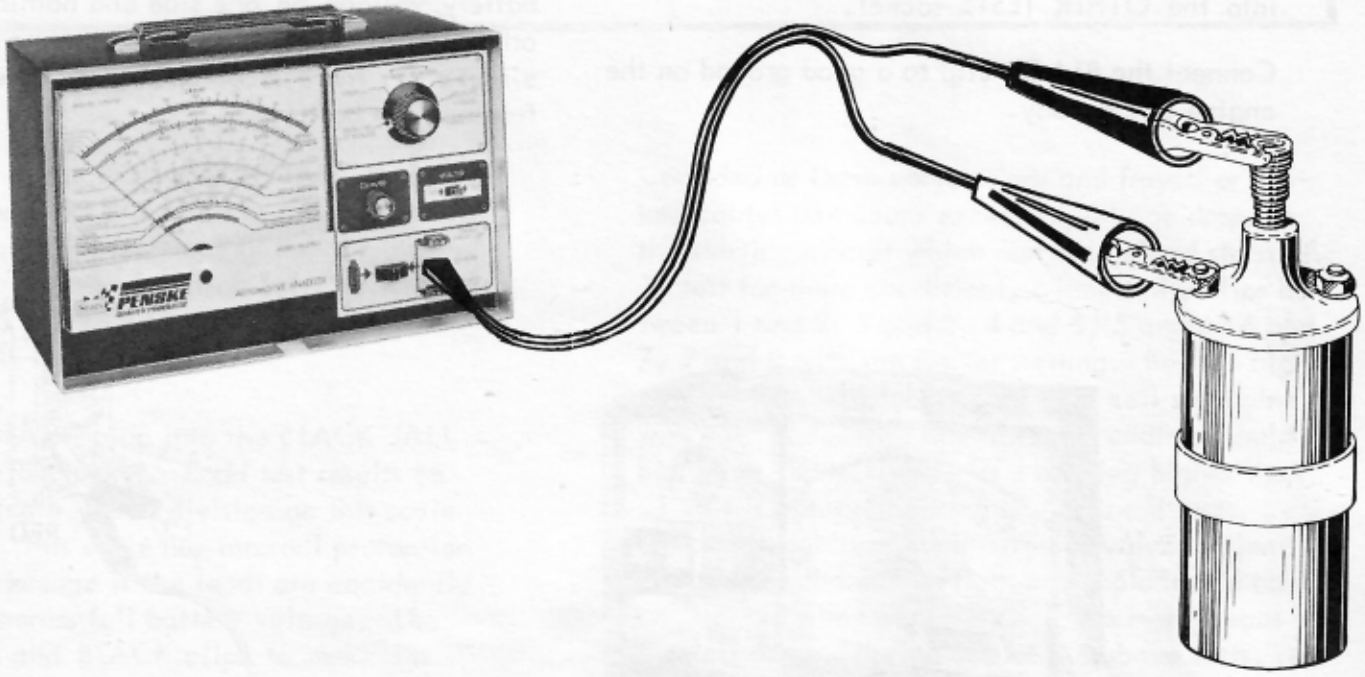
To check for grounds, touch the test leads from either slip ring to the rotor shaft or to the rotor poles. If the meter shows only a slight reading or none at all, the field winding is not grounded. If the meter reading is near full scale (right end), the winding is grounded.

The alternator stator winding may be checked for grounds or opens. Disconnect the three stator leads from the diodes before any test.

To check for opens, successively connect the tester leads between each pair of stator leads. In each case, if the meter reading is near full scale (right end), the windings are not open. If the meter shows only a slight reading or none at all, the winding is open.

To check for grounds, connect the tester leads to any stator lead and to the frame. If the meter shows only a slight reading or none at all, the stator is not grounded. If the meter is near full scale (right end), the stator winding is grounded to the frame.

COIL SECONDARY RESISTANCE ON OHMS x 1000 POSITION



1. Remove the high tension lead from the coil tower. Be sure ignition switch is OFF.

2. Connect one test lead to either coil screw terminal. (On late model Ford cars, use the Ford Adapter as illustrated on page 8.) Connect the other lead to a spark plug adapter and insert in the coil tower as shown.

3. Read the Ohms x 1000 scale on the Meter and compare the reading with the manufacturers specification in the next column.

TEST RESULTS

The resistance of most coils for standard ignition systems are given in the table below.

MANUFACTURER	SECONDARY RESISTANCE
American Motors	6,500 to 9,500
Chrysler	9,500 to 11,500
Ford	7,500 to 9,000
G.M. Delco Remy	5,500 to 9,500

If the reading is higher or lower than the manufacturers specification, the coil should be replaced.

FUSE TESTS

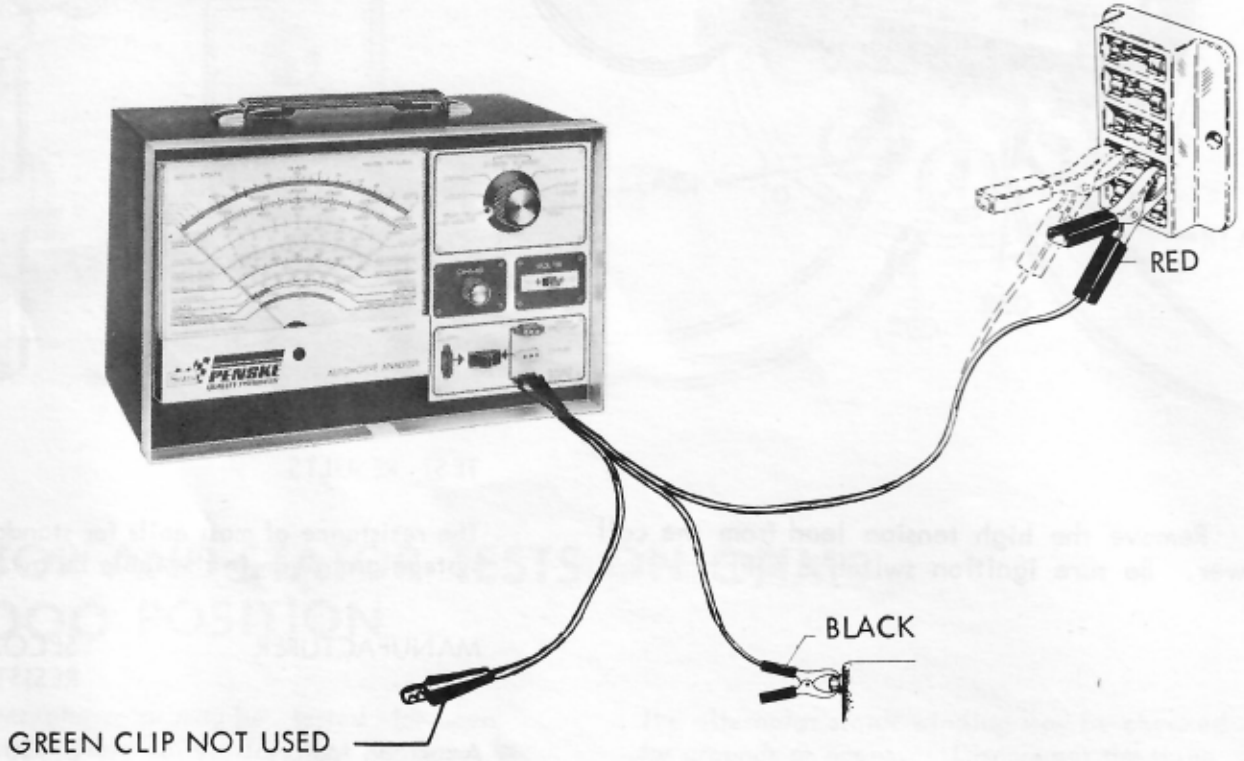
Automotive fuses can be tested as follows:

Turn the Function Selector Knob to the VOLTS position. Insert the BLACK plug into the OTHER TESTS socket.

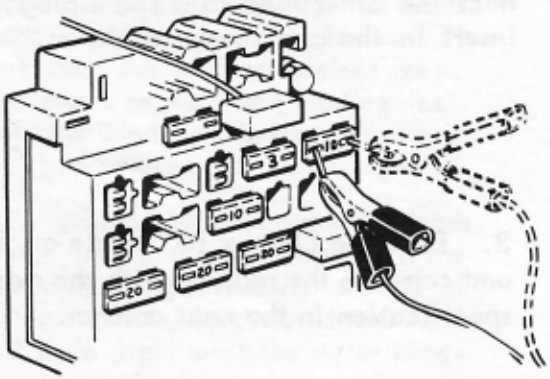
Connect the BLACK clip to a good ground on the engine or car body.

Turn the ignition switch to the ACC. position and turn on the accessory associated with the fuse that is to be tested. Then touch both sides of the fuse with the RED clip.

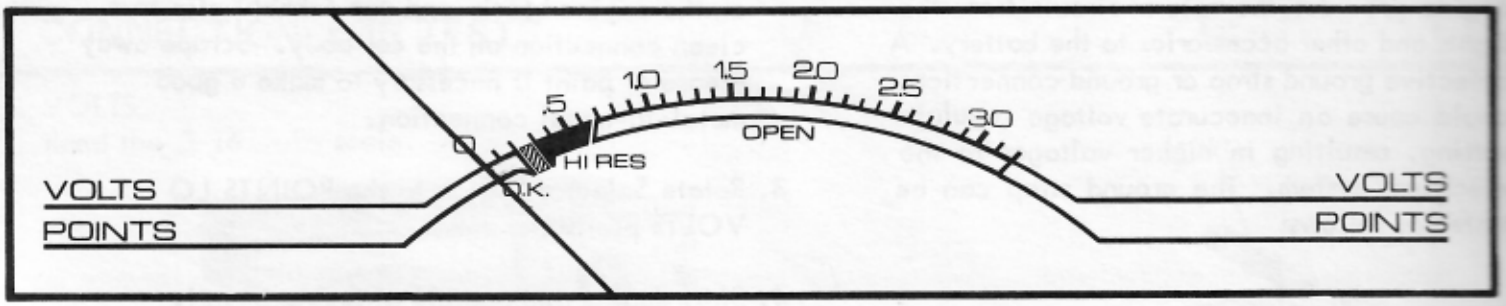
If the meter indicates battery voltage on both sides of the fuse, the fuse is good. If it indicates battery voltage on one side and nothing on the other, the fuse is open. If there is no reading on either side, there is an open circuit between the fuse and the battery.



On General Motors cars equipped with "Autofuse" blocks, insert a small nail or bare wire in the RED clip as shown and use it as a test probe.



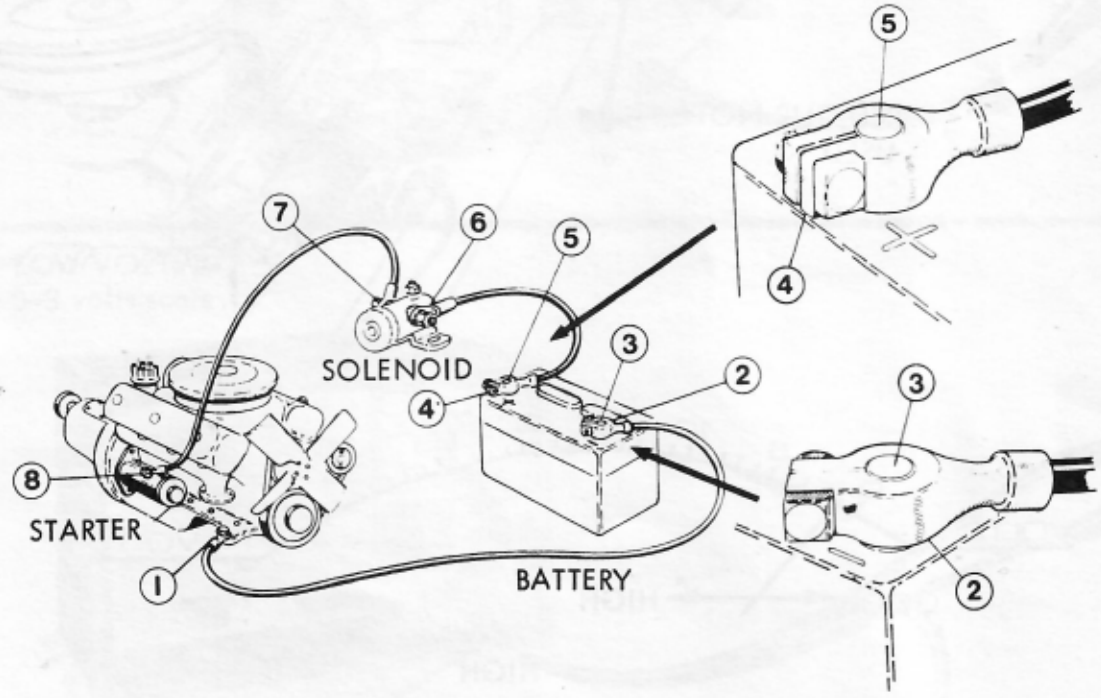
POINTS — LO VOLTS POSITION
VOLTAGE DROP TESTS



In addition to the POINT RESISTANCE test described on page 9, this position can be used to test the vehicle's electrical system for low voltage drops. Set the Function Selector Knob to the POINTS LO VOLTS position.

Insert the BLACK plug into the BLACK (ALL OTHER TESTS) socket. Read test results on the 0-3.0 scale. Each division on this scale is .1 volt. This scale has internal protection to prevent damage if the leads are accidently connected across full battery voltage. Use the GREEN and BLACK clips to make the tests. The RED clip is not used.

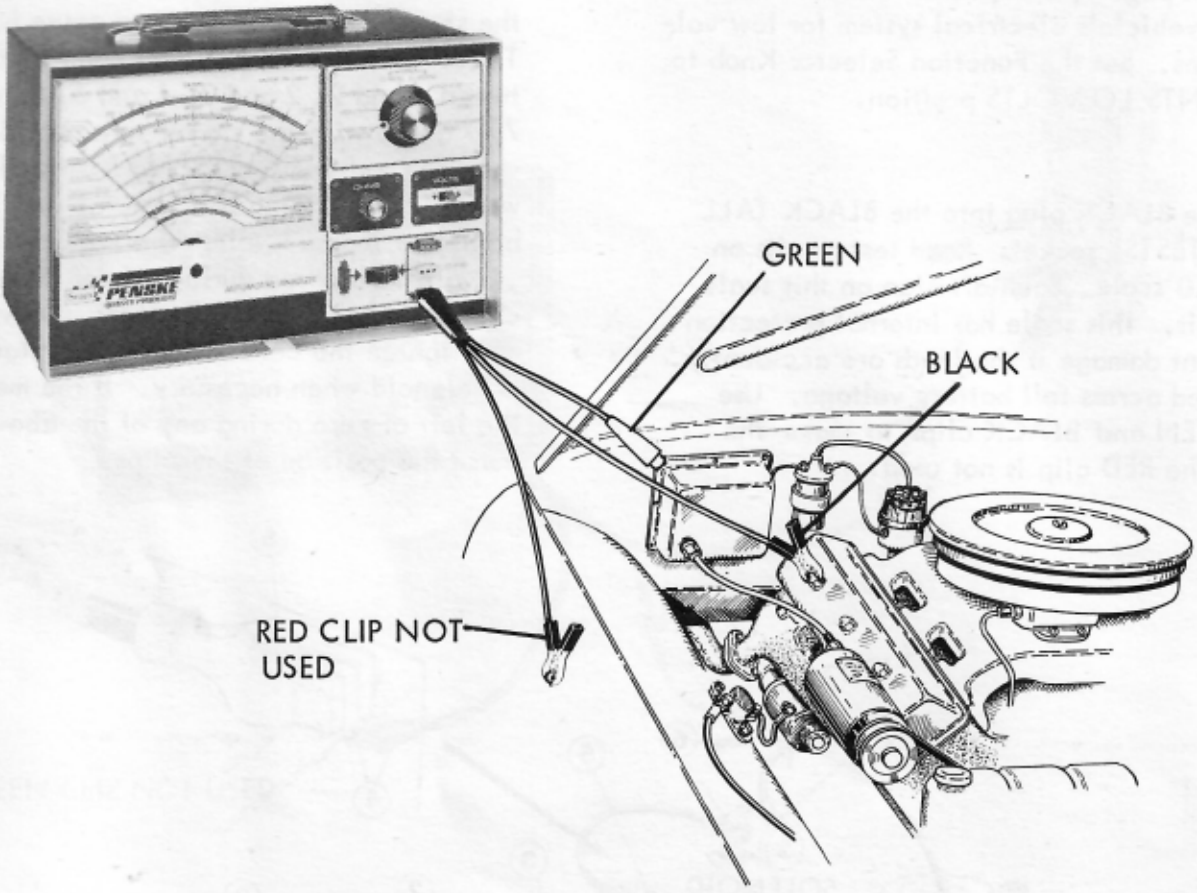
Corroded or loose connections and frayed or broken cables can cause excessive voltage drops in the starting circuit which can cause hard starting. To test for these conditions, connect the clips between 1 and 2, 2 and 3, 4 and 5, 5 and 6, 6 and 7, 7 and 8 with the starter turning. Be sure high voltage lead is disconnected from coil so engine won't start. During this test, no reading should be higher than .1 volt. If a reading higher than .1 volt is observed during any of these tests, check the cable or connections involved, clean and tighten the connections and replace the cables or solenoid when necessary. If the meter reads to the left of zero during any of the above tests, reverse the position of the clips.



GROUND STRAP TEST (ENGINE TO BODY)

The ground strap from the vehicle body to the engine provides the return circuit from the lights and other accessories to the battery. A defective ground strap or ground connections could cause an inaccurate voltage regulator setting, resulting in higher voltages to the electrical system. The ground strap can be tested as follows:

1. Insert the BLACK test lead plug into the BLACK "OTHER TESTS" socket.
2. Connect the BLACK clip to a clean connection on the engine block and the GREEN clip to a clean connection on the car body. Scrape away grease or paint if necessary to make a good metal-to-metal connection.
3. Rotate Selector Switch to the POINTS LO VOLTS position.
4. Start engine and operate at approximately 1200 RPM.
5. Turn on headlights and note reading on the 3 Volts scale.



GOOD

A reading less than .1 volt indicates a good ground strap and connections.

HIGH

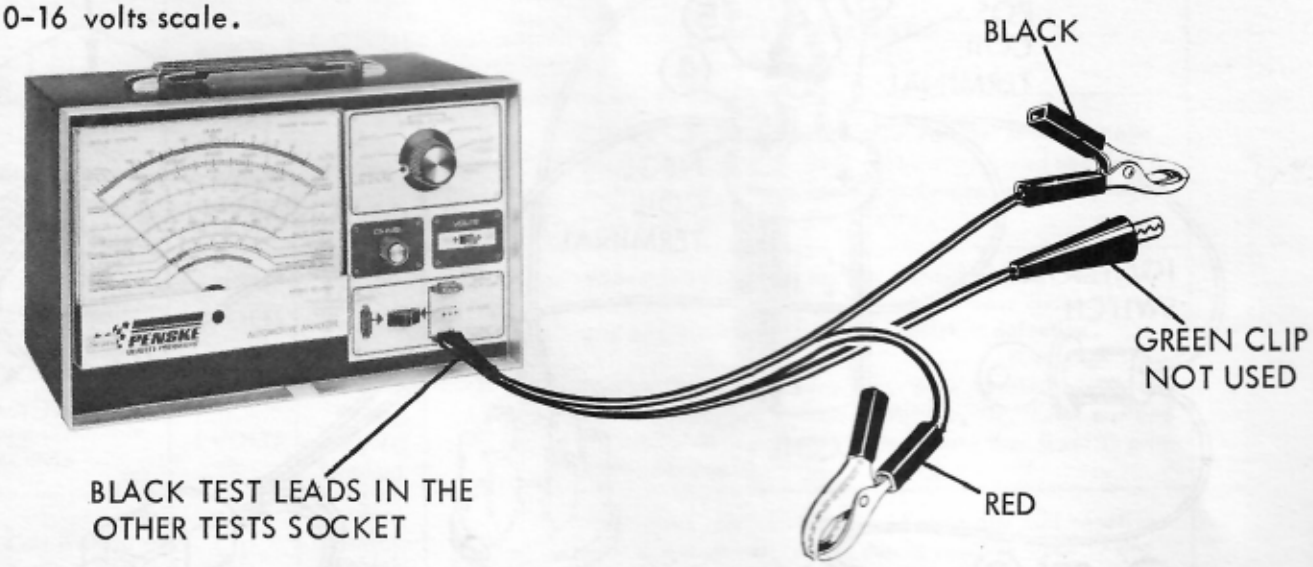
A reading exceeding .1 volt indicates a defective ground strap or its connections. Clean the ground strap connections and repeat test before replacing ground strap.

ELECTRONIC IGNITION SYSTEMS

Instructions for testing electronic ignition systems components are on pages 31-40.
For these tests the VOLTS, OHMS, and POINTS - LOW VOLTS positions are used.

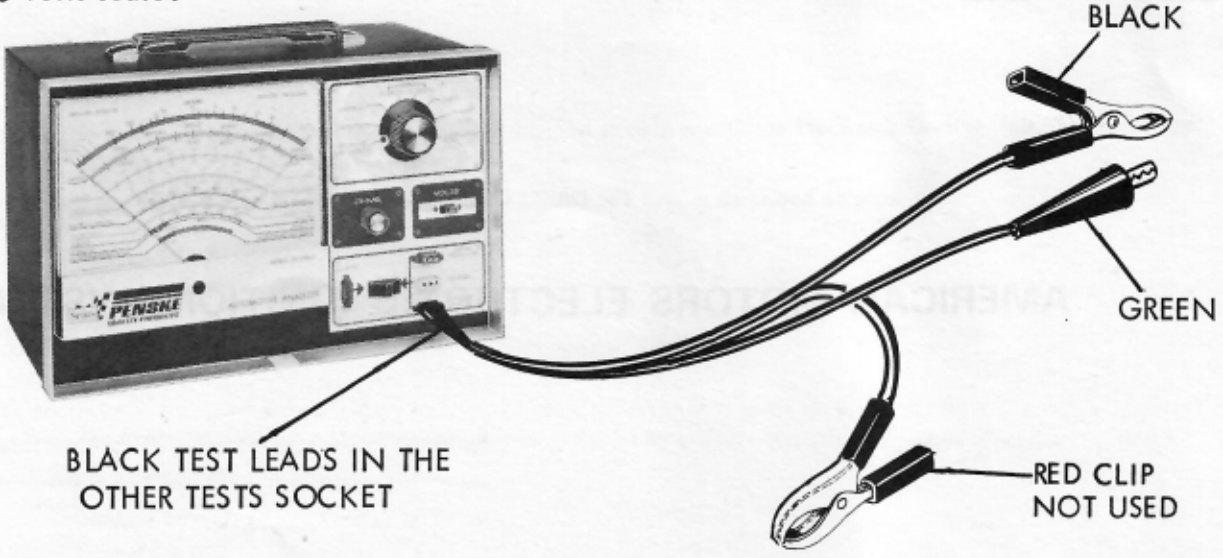
CONNECTION FOR TESTS

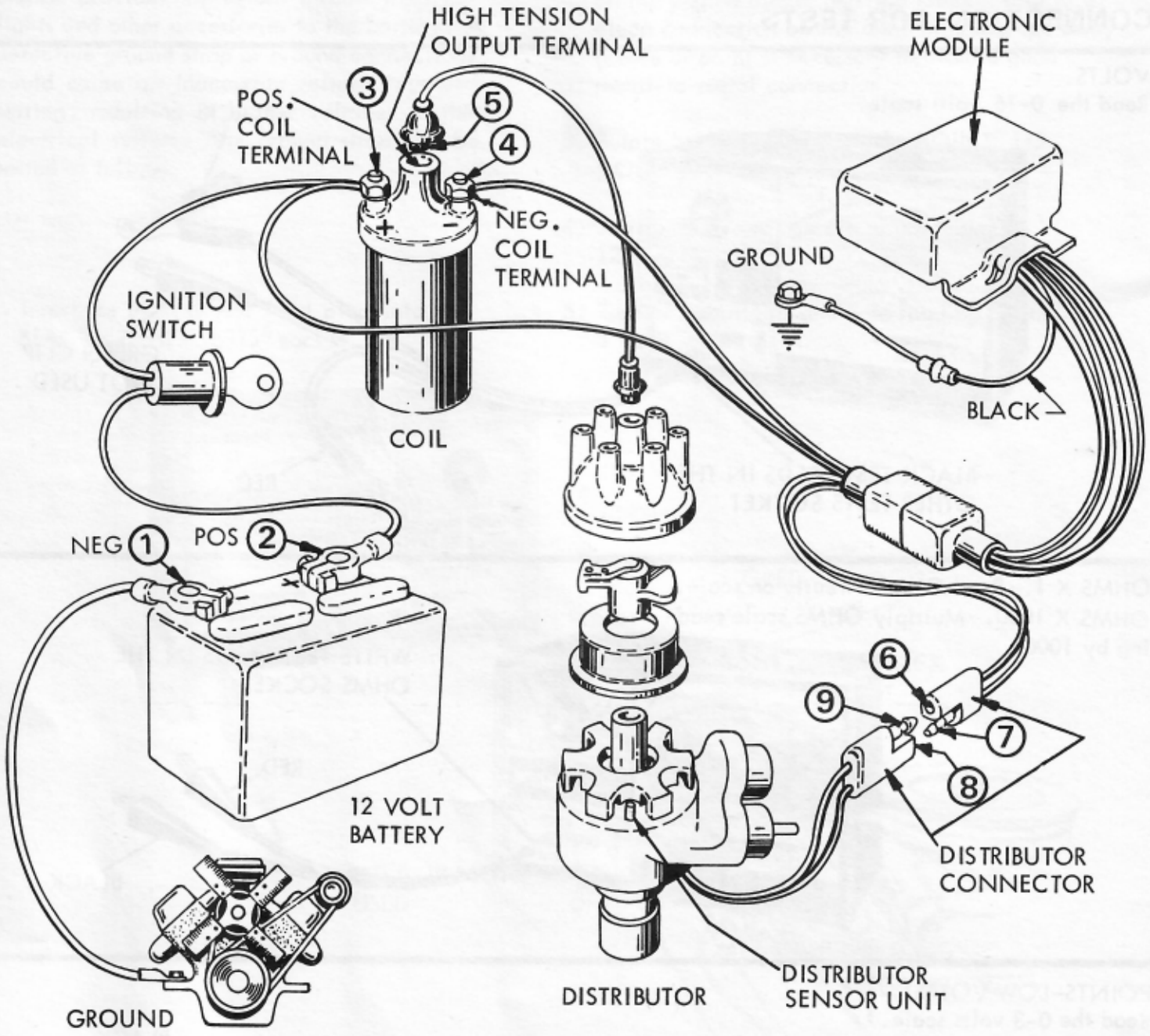
VOLTS.
Read the 0-16 volts scale.



OHMS X 1. Read OHMS directly on scale.
OHMS X 1000. Multiply OHMS scale reading by 1000.

POINTS-LOW VOLTS.
Read the 0-3 volts scale.





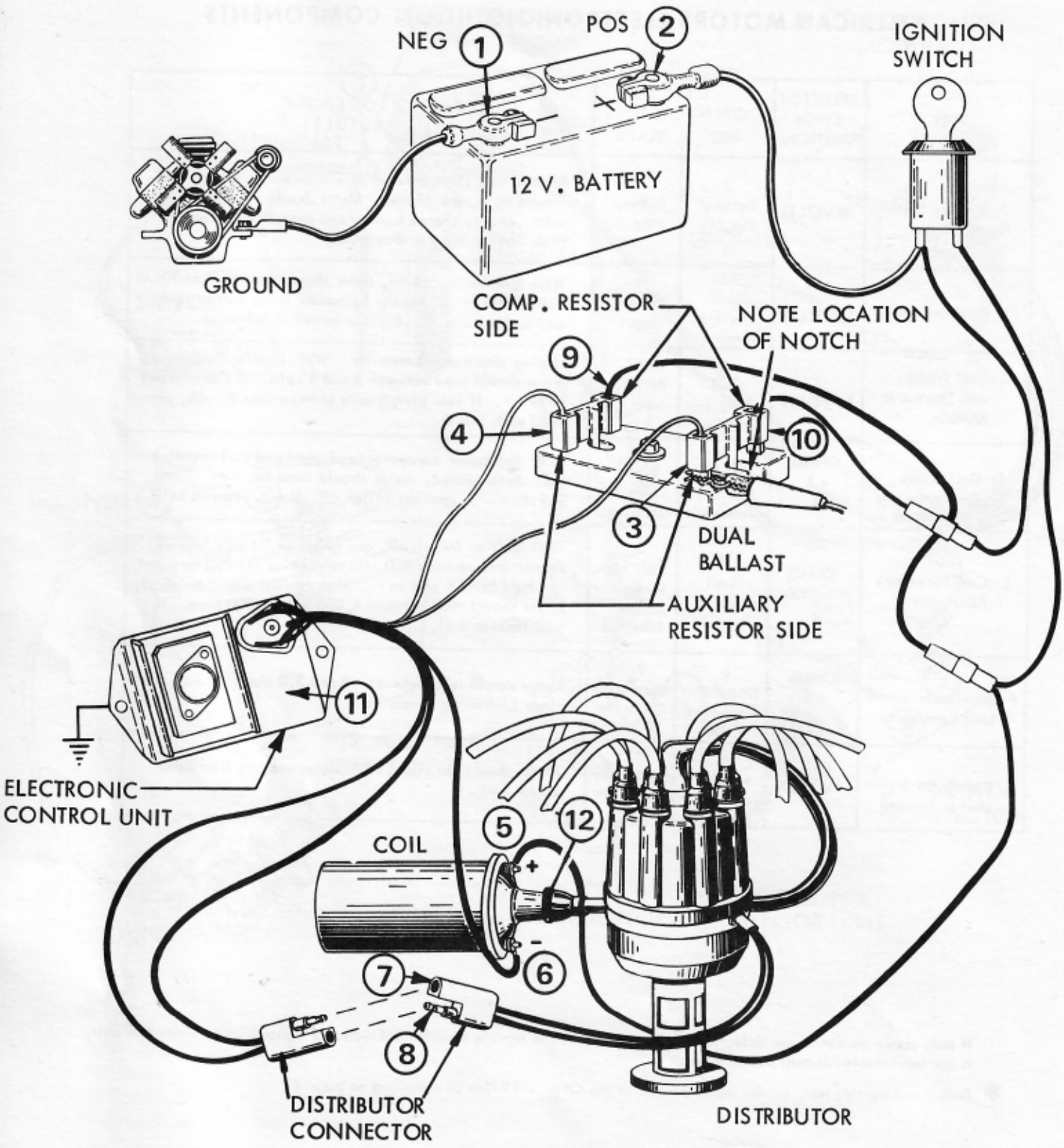
AMERICAN MOTORS ELECTRONIC IGNITION SYSTEM

AMERICAN MOTORS ELECTRONIC IGNITION COMPONENTS

TEST	SELECTOR KNOB POSITION	CLIP CONNECTIONS RED	CLIP CONNECTIONS BLACK	TEST PROCEDURE AND RESULTS
A Battery State of Charge	16 VOLTS	2 Battery Pos.(+)	1 Battery Neg.(-)	Remove Coil High Tension Wire from the distributor and ground it. Crank Engine. Meter should read above 9.0 volts. If not, charge battery and repeat test. Replace High Tension Wire in distributor.
B Ignition Switch	16 VOLTS	3 Coil Pos.(+) Terminal	1 Battery Neg.(-)	With Ignition Switch on, meter should read at least 10 volts. If not, inspect the switch for loose connections and faulty contacts. Replace switch if defective.
C Coil Primary and Electronic Module	16 VOLTS	4 Coil Neg.(-) Terminal	1 Battery Neg.(-)	Unplug distributor connector. With Ignition Switch on, meter should read between 5 and 8 volts. If OK proceed to Test F. If less than 5 volts or more than 8 volts, proceed with Test D.
D Coil Primary Resistance	OHMS x 1 *	3 Coil Pos.(+) Terminal	4 Coil Neg.(-) Terminal	With distributor connector unplugged and coil negative lead disconnected, meter should read between .7 and 2.5 ohms with Ignition Switch off. If not, replace coil.
E Coil Secondary Resistance	OHMS x 1000 *	3 Coil Pos.(+) Terminal	5 Coil high tension output Terminal	With Ignition Switch off, and negative (-) coil lead disconnected, connect RED clip to positive (+) coil terminal, and hold BLACK clip in coil high tension output terminal. Meter should read between 8,000 and 16,000 ohms. If not, replace coil.
F Distributor Sensor Unit Continuity	OHMS x 1 *	8 Distributor Connector Cavity	9 Distributor Connector Pin	Meter should read between .8 and 3.0 ohms. If not, replace Distributor Sensor Unit.
G Distributor Sensor Unit to Ground	OHMS x 1000 *	1 Battery Neg.(-)	9 Distributor Connector Pin	Meter should not move. If it does, replace Distributor Sensor Unit.

If tests above do not locate defective components, then the trouble is with the Electronic Control Unit. Since this unit is not serviceable, it must be replaced.

* Before making this test, set the meter pointer to the OHMS SET line as described on page 4.



CHRYSLER ELECTRONIC IGNITION SYSTEM

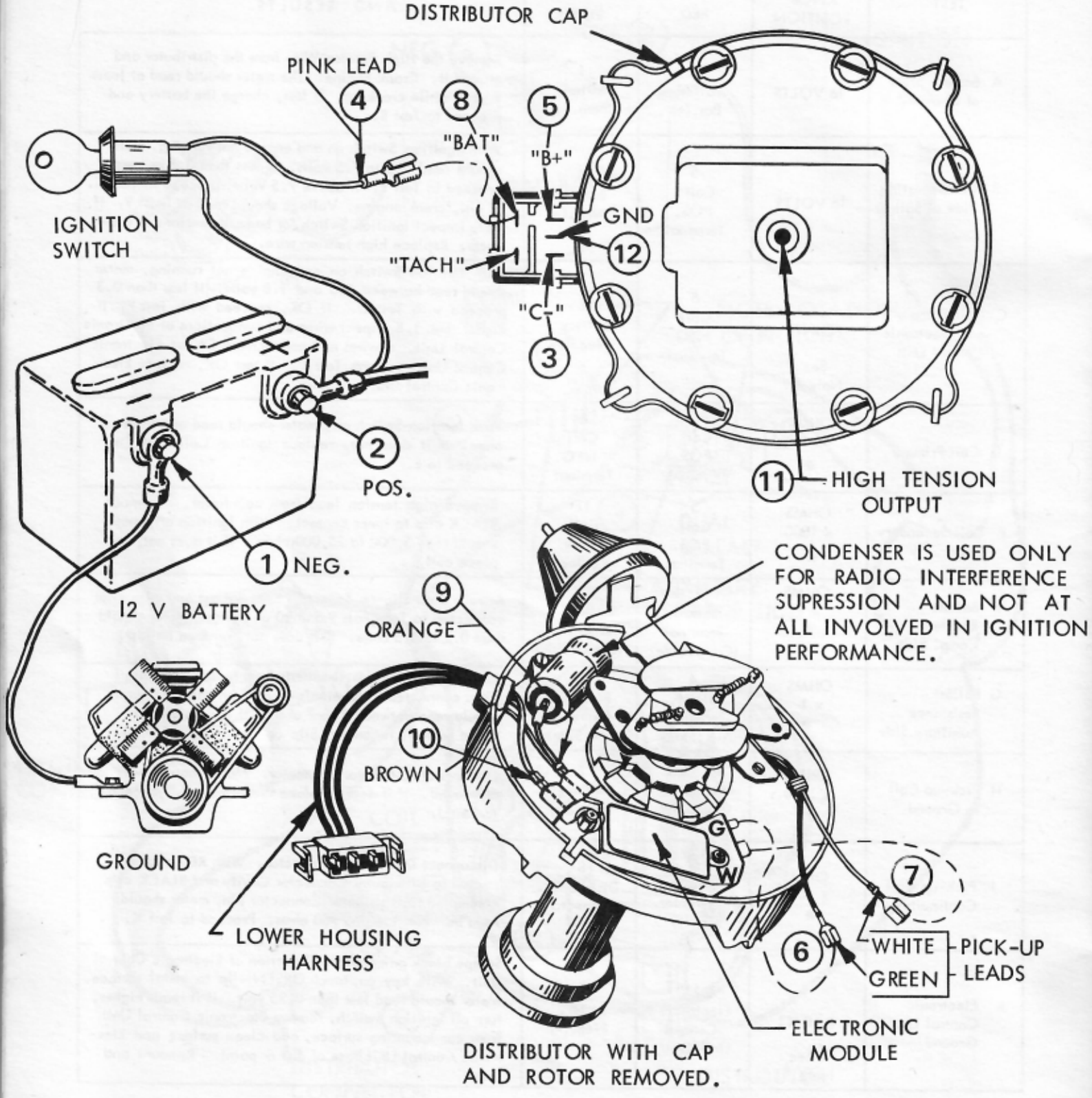
CHRYSLER ELECTRONIC IGNITION COMPONENTS

TEST	SELECTOR KNOB POSITION	CLIP CONNECTIONS RED	CLIP CONNECTIONS BLACK	TEST PROCEDURE AND RESULTS
A Battery State of Charge	16 VOLTS	2 Battery Pos.(+)	1 Battery Neg.(-)	Remove the High Tension Wire from the distributor and ground it. Crank Engine. The meter should read at least 9 volts while cranking. If less, charge the battery and proceed to Test B.
B Compensating Side of Ballast	16 VOLTS	5 Coil POS. Terminal	1 Battery Neg.(-)	With Ignition Switch on and engine not running, meter should read 3.5 to 7.5 volts. If less than 3.5 or zero proceed to Test E. If above 7.5 volts, proceed to Test C. If OK, crank engine. Voltage should read at least 9. If not, inspect Ignition Switch for bad connections or contacts. Replace high tension wire.
C Coil Primary and Electronic Control Unit	POINTS See Note #1	6 Coil NEG. Terminal	1 Battery Neg.(-)	With Ignition Switch on and engine not running, meter should read between 0.3 and 1.8 volts. If less than 0.3 proceed with Test D. If OK, proceed with Test F. If higher than 1.8, inspect wires and connections at Electronic Control Unit. If wires and connections OK at Electronic Control Unit, perform Test K. If test OK, replace Electronic Control Unit.
D Coil Primary	OHMS x 1 *	5 Coil POS. Terminal	6 Coil NEG. Terminal	With Ignition Switch off, meter should read one to three ohms. If it does not, replace Ignition Coil. If OK, proceed to E.
E Coil Secondary Continuity	OHMS x 1000 *	5 Coil POS. Terminal	12 Coil Tower Contact	Remove high tension lead from coil tower. Connect BLACK clip to inner contact. With Ignition off, meter should read 5,000 to 25,000 ohms. If it does not, replace coil.
F Ballast Resistance Comp. Side	OHMS x 1 *	9 Ballast Terminal (Comp.Side)	10 Ballast Terminal (Comp.Side)	Remove both Slip-on Terminals from Ballast and with clips connected to Terminals 9 and 10 on Ballast, meter should read 0.2 to 1.5 ohms. If it does not, replace Ballast.
G Ballast Resistance Auxiliary Side	OHMS x 1 *	4 Ballast Terminal (Aux.Side)	3 Ballast Terminal (Aux.Side)	Remove both Slip-on Terminals from Ballast and with clips connected to terminals 4 and 3 on Ballast, meter should read between 3 to 7 ohms. If it does not, replace Ballast, reconnect Slip-on Terminals at Ballast.
H Pick-up Coil to Ground	OHMS x 1000 *	8 Distributor Connector Pin	1 Battery Neg.(-)	Disconnect distributor connector. Meter should show no movement. If it does, replace Pick-up Coil. Proceed to Test J.
J Pick-up Coil Continuity	OHMS x 1000 *	7 Distributor Connector Cavity	8 Distributor Connector Pin	Disconnect Distributor Connector. With RED clip connected to Distributor Connector Cavity and BLACK clip connected to Distributor Connector Pin, meter should read between 150 and 900 ohms. Proceed to Test K.
K Electronic Control Unit Ground	POINTS See Note #1	11 Electronic Control Unit Case	1 Battery Neg.(-)	Scrape black paint off small section of Electronic Control Unit. With key on, touch GREEN clip to metal surface. Meter should read less than 0.25 volt. If it reads higher, turn off Ignition Switch, remove Electronic Control Unit from car mounting surface, and clean surface and Electronic Control Unit base of dirt or paint. Remount and retest.

Note #1 - Use GREEN and BLACK leads for this test only.

If tests above do not locate defective components, then the trouble is with the Electronic Control Unit. Since this unit is not serviceable, it must be replaced.

* Before making this test, set the meter pointer to the OHMS SET line as described on page 4.



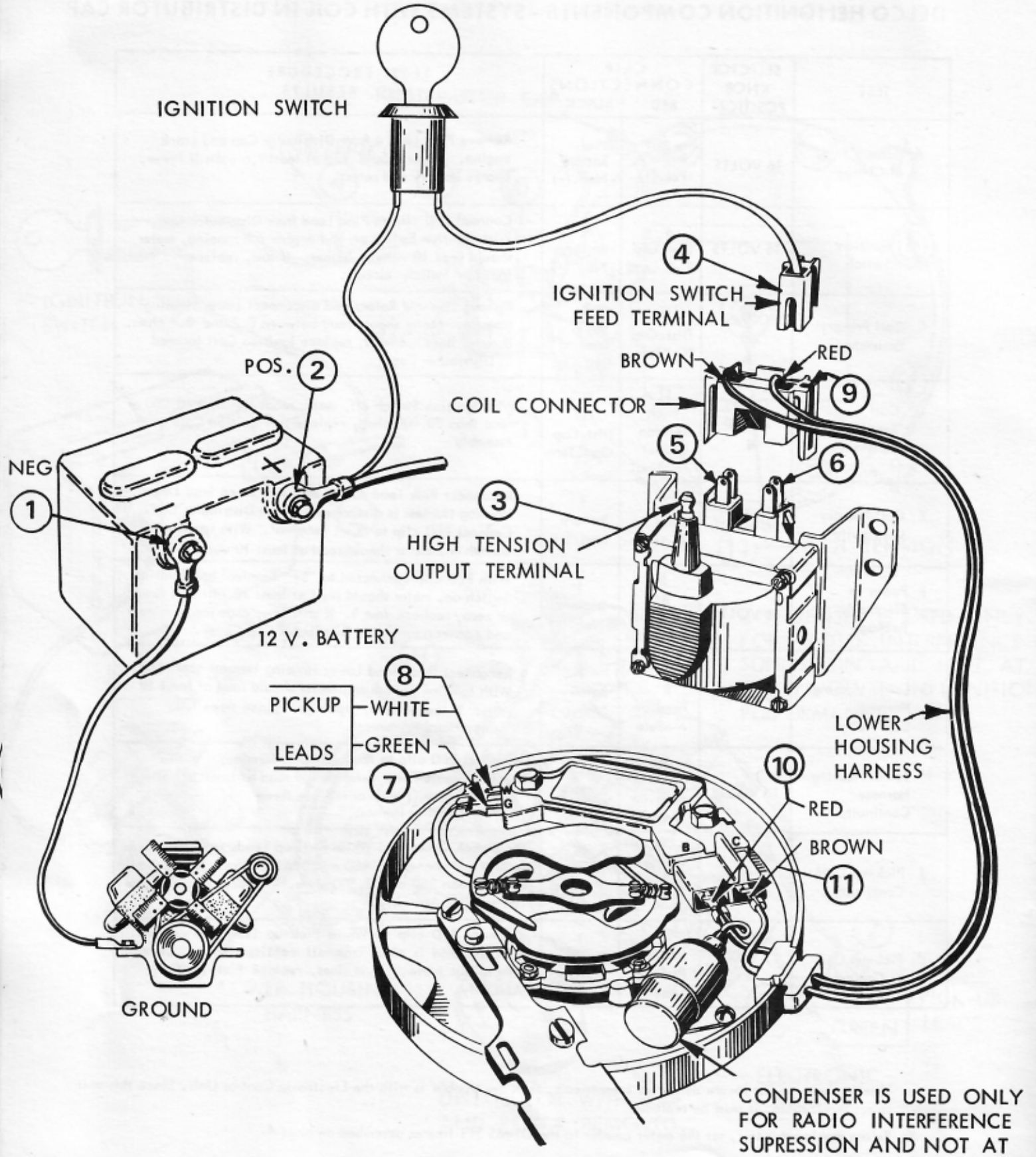
DELCO HEI IGNITION SYSTEM WITH COIL IN DISTRIBUTOR CAP

DELCO HEI IGNITION COMPONENTS—SYSTEMS WITH COIL IN DISTRIBUTOR CAP

TEST	SELECTOR KNOB POSITION	CLIP CONNECTIONS RED	CLIP CONNECTIONS BLACK	TEST PROCEDURE AND RESULTS
A Battery State of Charge	16 VOLTS	2 Battery Pos.(+)	1 Battery Neg.(-)	Remove Pink Lead 4 from Distributor Cap and crank engine. Meter should read at least 9.6 volts. If lower, charge battery and retest.
B Ignition Switch	16 VOLTS	4 Dist.Cap Pink Lead	1 Battery Neg.(-)	Connect RED clip to Pink Lead from Distributor Cap. With Ignition Switch on and engine not running, meter should read 10 volts or higher. If low, replace Ignition Switch circuit.
C Coil Primary Resistance	OHMS x 1 *	3 Dist.Cap "C-"Term.	8 BAT. Term.at Dist.Cap	Remove Cap and Rotor, and disconnect Lower Housing Harness. Meter should read between 0.2 and 0.7 ohms. If meter does not read, replace Ignition Coil located in Distributor Cap.
D Coil Secondary Resistance	OHMS x 1000 *	11 High Tension Output Terminal	12 Dist.Cap Gnd.Term	With Ignition Switch off, meter reads less than 10,000 or more than 30,000 ohms, replace the Ignition Coil Assembly.
E Coil Primary Continuity	16 VOLTS	3 Dist.Cap "C-"Term.	1 Battery Neg.(-)	Reconnect Pink Lead 4. Be sure that three lead Lower Housing Harness is disconnected from Distributor Cap. Connect RED clip to "C-" Terminal. With ignition Switch on, meter should read at least 10 volts.
F Power to Electronic Package	16 VOLTS	5 "B+" Term.at Dist.Cap	1 Battery Neg.(-)	With RED clip connected to "B+" Terminal and Ignition Switch on, meter should read at least 10 volts. If lower or zero, recheck Test B. If still low, examine terminals and connections inside Distributor Cap Cover.
G Lower Housing Harness Continuity	16 VOLTS	9 "B" Term.on Module	1 Battery Neg.(-)	Reconnect three lead Lower Housing Harness connectors. With Ignition Switch on, meter should read at least 10 volts. If low or zero, repair or replace three lead "Lower Housing Harness."
H Lower Housing Harness Continuity	16 VOLTS	10 "C-" Term.on Module	1 Battery Neg.(-)	Connect RED clip to Module "C-" Terminal. With Ignition Switch on, meter should read at least 10 volts. If low or zero, repair or replace three lead "Lower Housing Harness."
J Pick-up Coil Continuity	OHMS x 1000 *	7 White Pick-up Lead	6 Green Pick-up Lead	Disconnect Green and White Pick-up Leads from Electronic Module and connect to RED and BLACK clips. Meter should read between 550 and 1,500 ohms. If it does not, replace Pick-up Coil Assembly.
K Pick-up Coil to Ground	OHMS x 1000 *	7 White Pick-up Lead	1 Battery Neg.(-)	Connect RED clip to White Pick-up Lead. Be certain GREEN Lead is clear from all metal surfaces. Meter should not move. If it does, replace Pick-up Coil Assembly.

If tests above do not locate defective components, then the trouble is with the Electronic Control Unit. Since this unit is not serviceable, it must be replaced.

* Before making this test, set the meter pointer to the OHMS SET line as described on page 4.



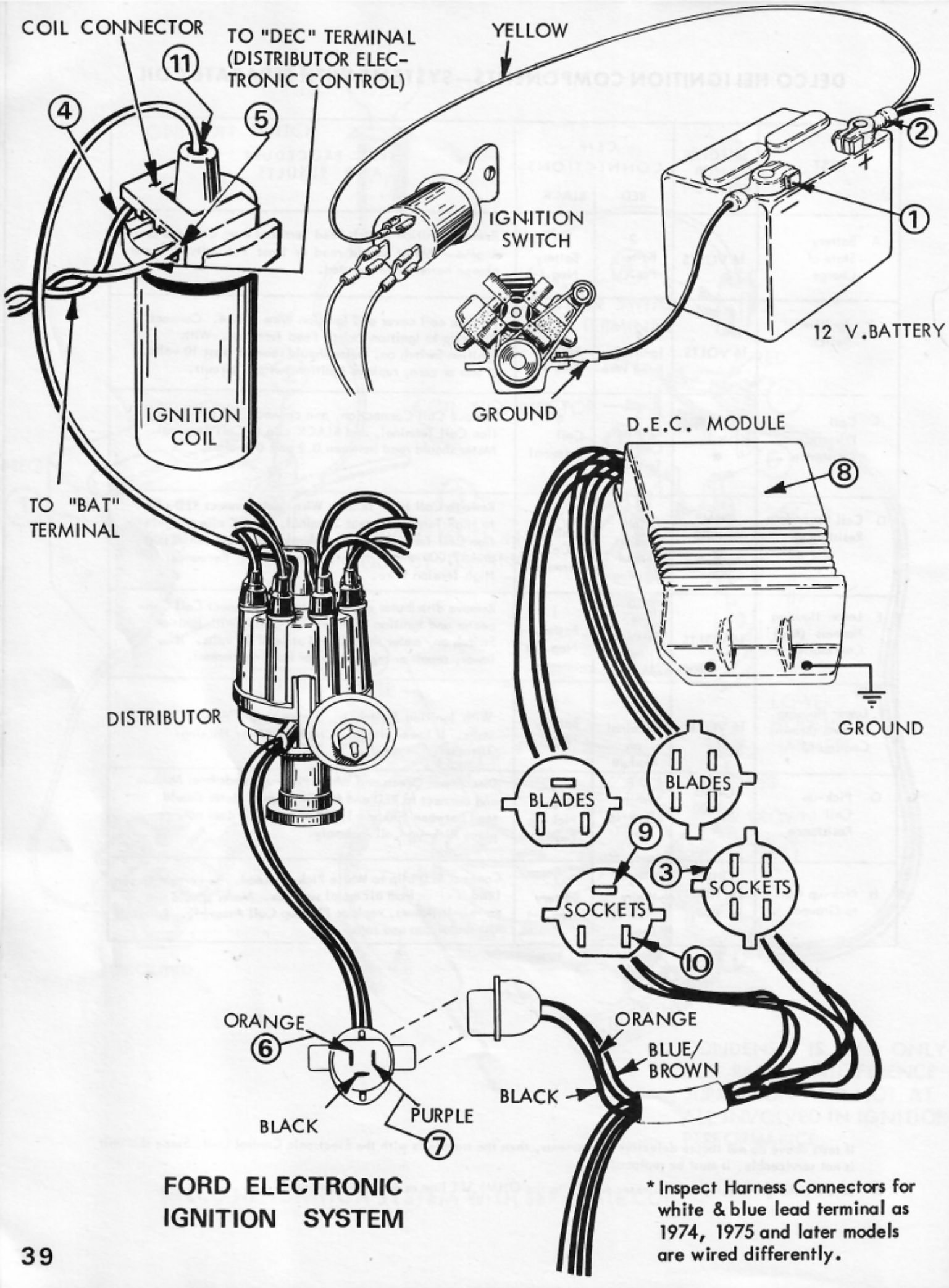
DELCO HEI IGNITION SYSTEM WITH SEPARATE COIL

DELCO HEI IGNITION COMPONENTS—SYSTEMS WITH SEPARATE COIL

TEST	SELECTOR KNOB POSITION	CLIP CONNECTIONS RED	CLIP CONNECTIONS BLACK	TEST PROCEDURE AND RESULTS
A Battery State of Charge	16 VOLTS	2 Battery Pos.(+)	1 Battery Neg.(-)	Remove Ignition Switch Feed Terminal from Coil and crank engine. Meter should read at least 9.6 volts. If lower, charge battery and proceed.
B Ignition Switch	16 VOLTS	4 Ignition Feed Wire	1 Battery Neg.(-)	Remove coil cover and Ignition Wire No. 4. Connect RED clip to Ignition Switch Feed Terminal. With Ignition Switch on, meter should read at least 10 volts. If low or zero, replace Ignition Switch circuit.
C Coil Primary Resistance	OHMS x 1 *	5 Ignition Coil Terminal	6 Coil Terminal	Remove Coil Connection, and connect RED clip to Ignition Coil Terminal, and BLACK clip to Coil Terminal. Meter should read between 0.2 and 0.7 ohms.
D Coil Secondary Resistance	OHMS x 1000 *	3 High Tension Output Terminal	5 Ignition Coil Terminal	Remove Coil High Tension Wire, and connect RED clip to High Tension Output Terminal, BLACK clip to Ignition Coil Terminal. Meter should read between 6,000 and 12,000 ohms. If not, replace coil. Reconnect High Tension Wire.
E Lower Housing Harness (Red) Continuity	16 VOLTS	10 "B" Terminal on Module	1 Battery Neg.(-)	Remove distributor cap and rotor. Reconnect Coil Connector and Ignition Feed Wire to Coil. With Ignition Switch on, meter should read at least 10 volts. If lower, repair or replace Lower Housing Harness.
F Lower Housing Harness (Brown) Continuity	16 VOLTS	11 "C" Terminal on Module	1 Battery Neg (-)	With Ignition Switch on, meter should read at least 10 volts. If lower, repair or replace Lower Housing Harness.
G Pick-up Coil Resistance	OHMS x 1000 *	8 White Pick-up Lead	7 Green Pick-up Lead	Disconnect Green and White Pick-up Leads from Module and connect to RED and BLACK clips. Meter should read between 500 and 1,500 ohms. If it does not, replace Pick-up Coil Assembly.
H Pick-up Coil to Ground	OHMS x 1000 *	8 White Pick-up Lead	1 Battery Neg.(-)	Connect RED clip to White Pick-up Lead. Be certain Green Lead is clear from all metal surfaces. Meter should not move. If it does, replace Pick-up Coil Assembly. Reinstall distributor cap and rotor.

If tests above do not locate defective components, then the trouble is with the Electronic Control Unit. Since this unit is not serviceable, it must be replaced.

* Before making this test, set the meter pointer to the OHMS SET line as described on page 4.



FORD ELECTRONIC IGNITION SYSTEM

* Inspect Harness Connectors for white & blue lead terminal as 1974, 1975 and later models are wired differently.

FORD ELECTRONIC IGNITION COMPONENTS

TEST	SELECTOR KNOB POSITION	CLIP CONNECTIONS RED	CLIP CONNECTIONS BLACK	TEST PROCEDURE AND RESULTS
A Battery State of Charge	16 VOLTS	2 Battery Pos. (+)	1 Battery Neg. (-)	Remove Coil High Tension Wire from the distributor and ground it. Crank Engine. Meter should read at least 9 volts. If less, charge battery and proceed. Replace High Tension Wire.
B Resistance Wire	OHMS x 1 *	9	10	With Ignition Switch OFF, meter should read 1 to 2 ohms. If reading is higher, replace resistance wire.
C Coil Primary Resistance	OHMS x 1 *	4 Coil BAT. Terminal	5 Coil DEC Terminal	With Ignition Switch off, meter should read 1 to 3 ohms. If it does not, replace Ignition Coil. If OK, proceed with Test D.
D Coil Secondary Continuity	OHMS x 1000 *	4 Coil BAT. Terminal	11 Coil Tower Contact	Remove coil high tension lead from coil tower. Connect BLACK clip to inner contact. With Ignition Switch off, meter should read 5,000 to 25,000 ohms. If it does not, replace coil.
E Voltage Drop in Resistance Wire	16 VOLTS	2 Battery Pos. (+)	4 Coil BAT. Terminal	With Ignition Switch on, meter should read 5 to 7 volts. If higher than 7 volts, recheck Test B. If lower, proceed with Tests F and G.
F Power to DEC Module	16 VOLTS	3 White/Blue Lead Terminal	1 Battery Neg. (-)	Separate the Harness Connector containing White/Blue Wire from DEC Module, and connect RED clip to White/Blue Female Lead Terminal. With Ignition Switch on, meter should read 10 to 13 volts. If low or zero, perform voltage drop test on Ignition Switch Resistance Wire, Test E. If OK, replace Ignition Switch.
G Pick-up Coil to Ground	OHMS x 1000 *	6 Orange Distributor Pick-up Connector Terminal	1 Battery Neg. (-)	Meter should not move. If there is movement or a full scale reading, replace Pick-up Coil Assembly.
H Pick-up Coil Continuity	OHMS x 1000 *	6 Orange Distributor Pick-up Connector Terminal	7 Purple Distributor Pick-up Connector Terminal	Meter should read between 400 and 800 ohms. If it reads higher or lower, replace Pick-up Coil Assembly.
J Module Ground	POINTS See Note #1	8 DEC Module Case	1 Battery Neg. -	With Ignition Switch on, momentarily touch GREEN clip to DEC Module Housing. If meter reads more than 0.25 volt, remove Module from mounting, clean surfaces, remount securely and retest.

Note #1 - Use GREEN and BLACK leads for this test only.

If tests above do not locate defective components, then the trouble is with the Electronic Control Unit. Since this unit is not serviceable, it must be replaced.

* Before making this test, set the meter pointer to the OHMS SET line as described on page 4.

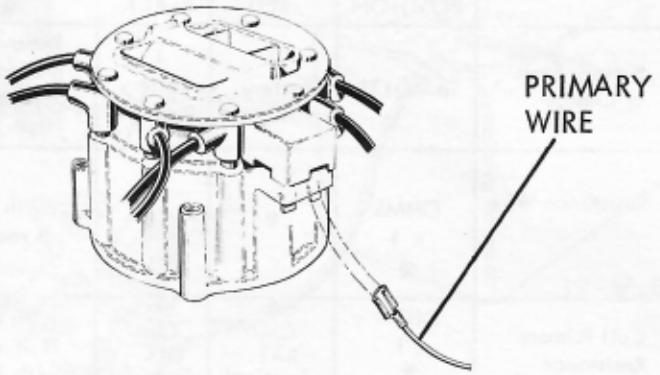
NOTE

GENERAL MOTORS HIGH ENERGY IGNITION — DISABLING PROCEDURES

When performing Charging System tests on General Motors vehicles equipped with High Energy Ignition (HEI), the engine can be prevented from starting as follows:

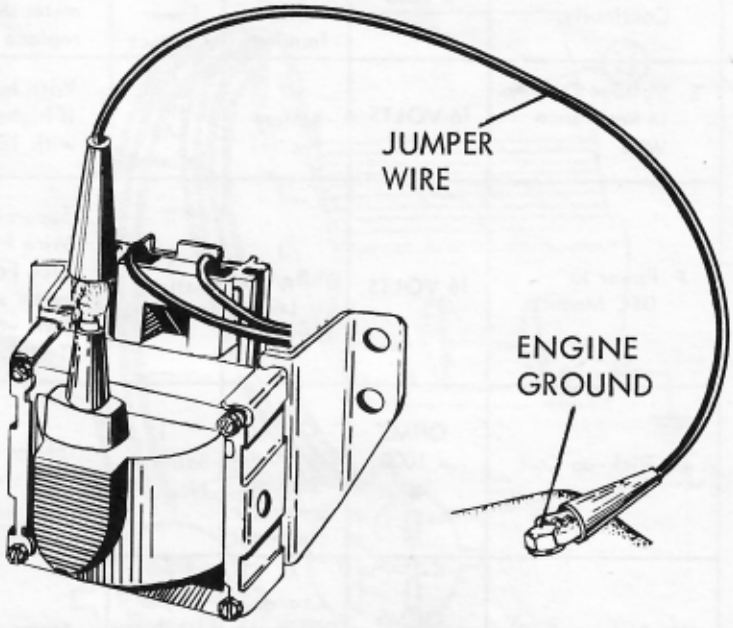
SYSTEMS WITH COIL IN DISTRIBUTOR CAP

Disconnect primary wire from the BAT terminal on the distributor cap.



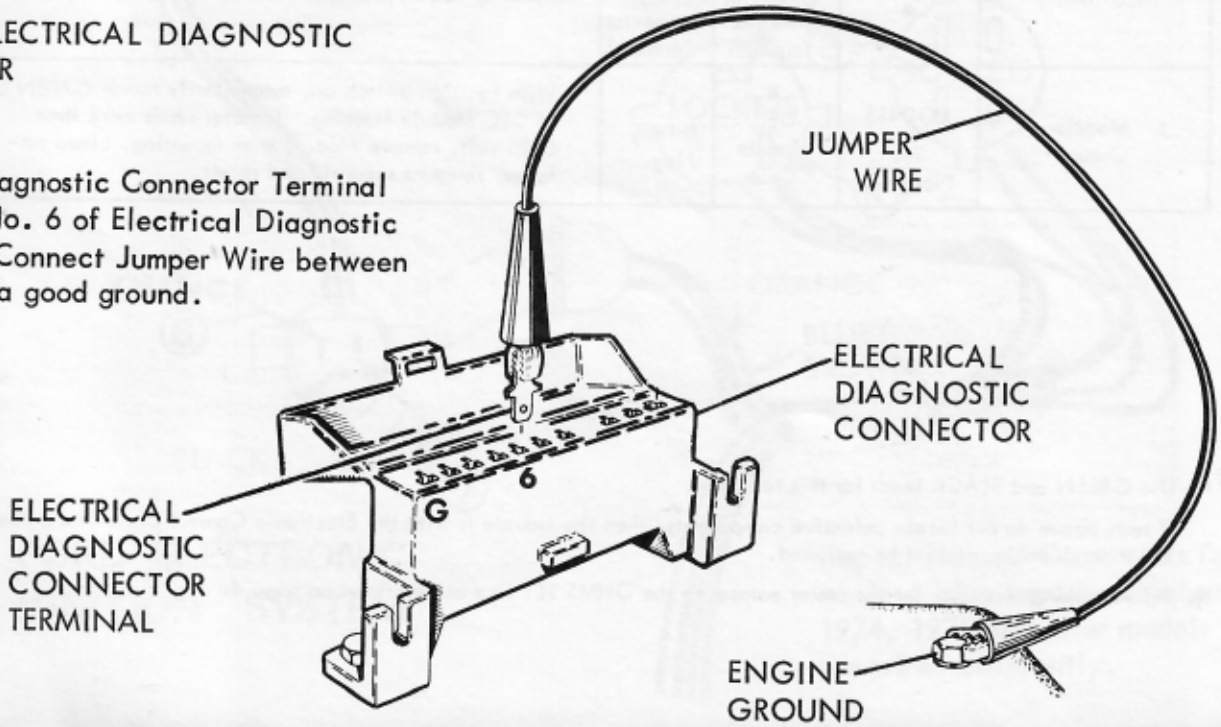
SYSTEMS WITH SEPARATE COIL

Remove high-tension coil wire from coil secondary terminal. Connect Jumper Wire between coil secondary terminal and a good ground on the engine.



HEI WITH ELECTRICAL DIAGNOSTIC CONNECTOR

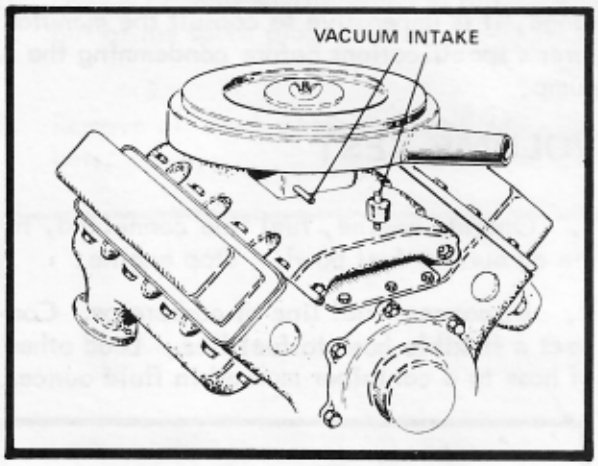
Insert GM Diagnostic Connector Terminal in terminal No. 6 of Electrical Diagnostic Connector. Connect Jumper Wire between terminal and a good ground.



VACUUM GAUGE TESTING

ENGINE CONDITION TEST

1. Connect the vacuum gauge to a source of intake manifold vacuum.



2. Operate the engine at normal temperature and idle speed.

3. Note vacuum gauge reading.

TEST RESULTS

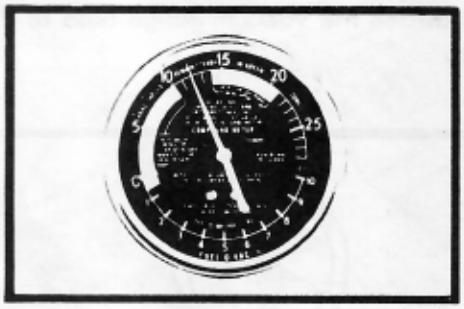
A steady reading of between 15 and 22 indicates a mechanically sound engine.

A pointer which sweeps or wanders erratically through several inches indicates a malfunction affecting all cylinders unequally and not consistently. To help isolate the trouble area, run the engine at about 2000 RPM. If the pointer steadies, check:

Ignition and timing
Centrifugal advance, (loose springs at idle).

If the sweeps become shorter and more rapid, check for:

Intake system leaks
Sticky valves
Weak or broken valve springs



A low, but steady reading indicates a loss of power affecting all cylinders alike. Check for:

Late Timing
Intake system leaks
Warped intake manifold
Leaky carburetor flange gasket

PCV SYSTEM TEST

1. Operate the engine at normal temperature and idle speeds.

2. Remove the air cleaner hose from the rocker arm cover or closed oil filler cap.

3. Hold the vacuum gauge rubber hose fitting firmly over the engine opening. Note gauge reading.

TEST RESULTS

A. A properly working PCV System will draw a vacuum of about 3 to 5 inches within 10 seconds.

B. If there is very little change in gauge reading, the PCV valve is clogged or there are excessive air leaks into the crankcase and the engine may not be properly ventilated.

EXHAUST RESTRICTION TEST

1. With vacuum gauge connected to a source of manifold vacuum, increase engine speed to 2000 RPM, maintain this speed, and note the vacuum gauge reading.

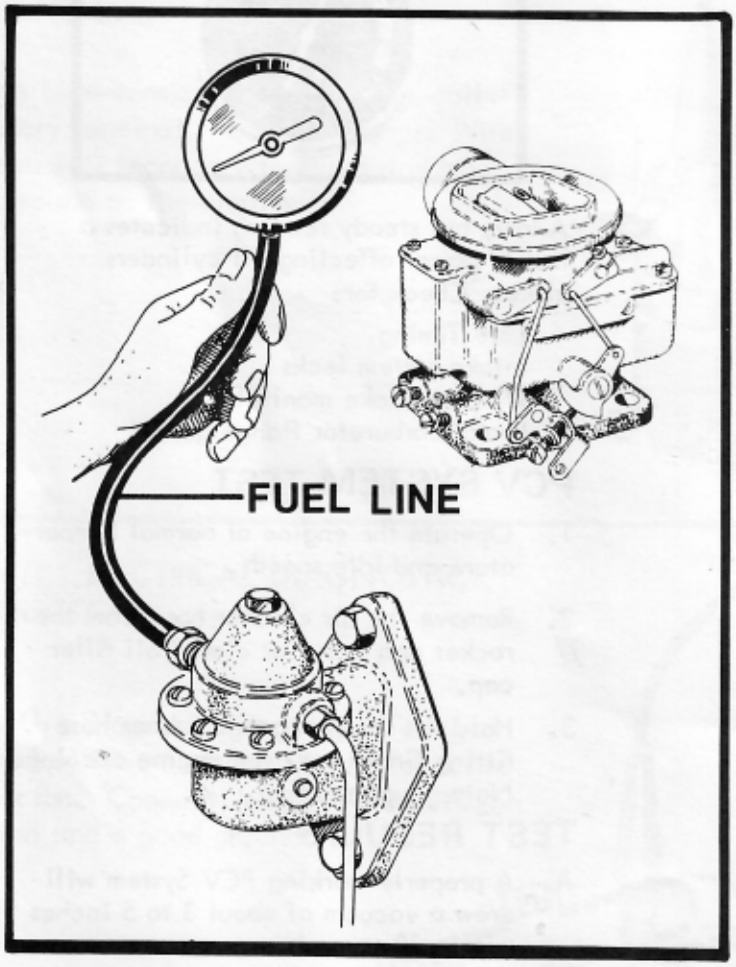
TEST RESULTS

A gradually decreasing vacuum may indicate a restricted exhaust system.

FUEL PUMP TEST

PRESSURE TEST

1. Disconnect the fuel line at the carburetor and attach the vacuum gauge hose to the fuel line.



2. Operate engine at idle. Hold gauge at carburetor height and note gauge reading.

3. Reconnect fuel line to carburetor.

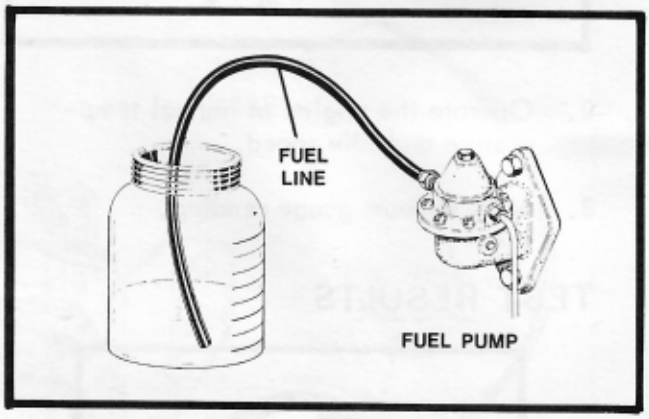
TEST RESULTS

Gauge reading must compare with manufacturer's specifications. If specifications are not immediately available, fuel pump pressure can be considered satisfactory if it is between 4 and 6 PSI with lower readings for smaller displacement engines. If pressure reading falls outside this range, it is imperative to consult the manufacturer's specifications before condemning the fuel pump.

VOLUME TEST

1. Operate engine, fuel line connected, to fill the carburetor fuel bowl. Stop engine.

2. Disconnect fuel line at carburetor. Connect a flexible hose to fuel line. Lead other end of hose to a container marked in fluid ounces.



3. Operate the engine and collect the discharge from the fuel pump for 30 seconds. Stop engine and reconnect fuel line.

CAUTION: Care must be exercised to avoid spilling of the fuel or the starting of a fire.

TEST RESULTS

Consult manufacturer's specifications for exact delivery rate. Otherwise, be guided by the following table.

Engine displacement in Cubic inches	Ounces collected in 30 Seconds
Up to 225	8
225 to 350	10
Over 350	11

COMPRESSION

1. With engine stopped and at normal operating temperature, loosen all spark plugs about one turn.

2. Use an air hose or tire pump to blow the dirt out of the spark plug wells.

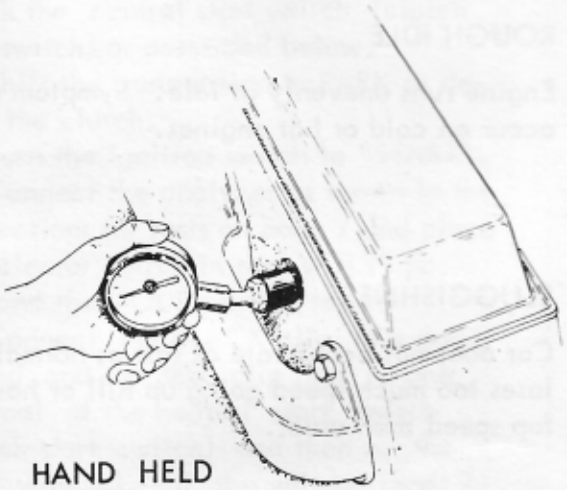
3. Remove all spark plugs and spark plug gaskets.

4. Set the carburetor throttle valve wide open, and ground the secondary coil wire.

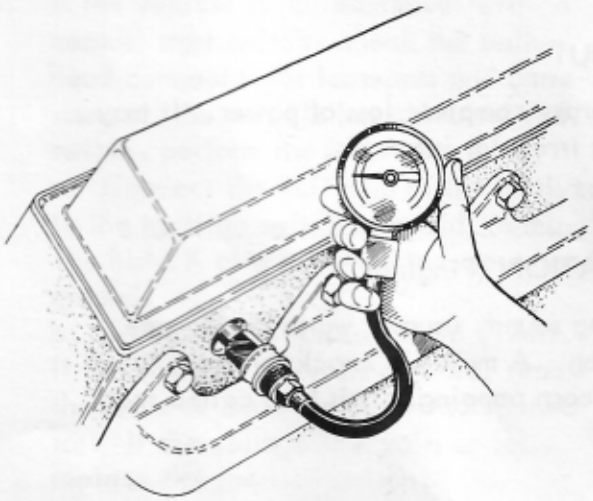
5. Screw or hold (depending on type) the compression gauge to the spark plug hole.

6. Crank engine for at least four compression strokes. Note and record the reading on first full stroke as well as on final stroke.

NOTE: Repeat the above step on all cylinders.



HAND HELD



FLEXIBLE DRIVE

TEST RESULTS

A. NORMAL - Compression builds up evenly to specified reading and varies less than 10-15 pounds between cylinders (highest to lowest).

B. RING PROBLEMS - Compression low on first stroke, builds up on successive strokes, but not to specification.

C. VALVE PROBLEMS - Low compression on first stroke and does not build up much on successive strokes.

NOTE: To differentiate between valves and rings, pour a teaspoon of S.A.E. #30 oil into each cylinder and retest:

a. A small or no increase in compression indicates bad valves.

b. A considerable increase (10 or more pounds) in compression indicates poorly seated or worn piston rings.

D. LEAKING HEAD GASKET - Results are the same as Valve Problems on two adjacent cylinders. Problem is usually accompanied by indications of water and/or oil in cylinder.

E. CARBON DEPOSITS - Readings are considerably higher than specifications due to accumulation of carbon between piston top and cylinder head. Using a spark plug with higher heat range sometimes corrects this fault.

The following pages describe common engine and electrical system problems and their solution. Maximum benefit will be derived from this guide if you use it in conjunction with the Service Manual for your vehicle. The Owners Manual furnished with the car will have the necessary information on where to obtain the Service Manual.

PERFORMANCE PROBLEMS DEFINITIONS

CUTS OUT

A temporary complete loss of power. It may occur at irregular intervals.

DETONATION (Pinging)

A pinging sound, usually worse during acceleration. A metallic knock that may sound like popcorn popping. It is also called spark knock.

DIESELING

Engine continues to run after ignition is turned off. Knocking and uneven running may occur. The exhaust has a foul odor.

HESITATION

A momentary lack of response when the gas pedal is depressed. This can occur at any speed and may cause engine stalling.

MISSING

A steady pulsation or jerking that follows engine speed, usually more pronounced as the engine load increases. It is not normally felt above 1500 RPM. The exhaust has a steady spitting sound at idle.

ROUGH IDLE

Engine runs unevenly at idle. Symptom may occur on cold or hot engines.

SLUGGISHNESS

Car does not accelerate as fast as normal. It loses too much speed going up hill or has less top speed than usual.

SPONGINESS

Little or no increase in speed as pedal is depressed. Continued pressing of the pedal will finally give an increase in speed.

STALLING

Engine stops running. This condition may occur with a cold or a hot engine.

SURGING

Car speeds up or slows down with no change in accelerator pedal.

STARTER WILL NOT CRANK ENGINE AND SOLENOID DOES NOT CLICK

1. a. Turn the ignition switch ON.
   b. Turn on the headlights as a check on the battery. If the lights do not operate, go to Step 7. If the lights operate normally, shut them off and go to Step 2 if the vehicle is equipped with a neutral start switch or a clutch start switch. If the vehicle has an automatic transmission, but does not use a neutral start switch go to Step 4.

2. Check the neutral start switch (clutch start switch) as described below.
   a. Shift the transmission to PARK or depress the clutch.
   b. Turn the ignition switch to "START".
   c. Connect the analyzer as shown in the connections for tests on page 7 and place the selector switch in the VOLTS position and the VOLTS switch to 16.
   d. Connect the BLACK clip to a good ground and the RED clip first to one terminal of the neutral start switch (clutch start switch) and then to the other terminal. If the voltage reads 7 or more on only one terminal, replace the neutral start switch (clutch start switch.) If the voltage reads 7 volts or more on both terminals go to Step 3. If there is no voltage on either terminal go to Step 6.

3. If the vehicle is equipped with a seat belt interlock, push the under-hood starter button. See your owner's manual for location and details. If the vehicle still does not crank go to Step 4.

4. a. Connect the analyzer as shown in the connections for tests on page 7 and place the function selector switch to VOLTS, and the VOLTS switch to 16.
   b. Connect the BLACK clip to a good engine ground and the RED clip to the starter solenoid terminal that goes to the ignition switch. On GM vehicles this terminal is marked with an S.
   c. Turn the ignition switch to START. If the voltmeter reads over 7 volts go to Step 5. If the voltmeter reads less than 7 volts go to Step 6.

5. Check for loose or corroded starter connections. Make the voltage drop tests as described on page 28. Repair as necessary. If the connections are OK repair or replace the starter/solenoid.

6. If the vehicle is not equipped with a neutral start switch, check the bulkhead connector for looseness and corrosion. If the vehicle has a neutral start switch, perform the following test.
   a. Connect the RED clip of the analyzer to the ignition switch solenoid terminal. The BLACK clip is connected to a good ground.
   b. Turn the ignition switch to START. If the voltage is 7 volts or more, repair the loose or corroded bulkhead connector. If the voltage is 7 volts or less, replace the ignition switch.

7. Check the battery for damage, loose or corroded cables or connections or for a loose ground connection at the engine. Repair as necessary. If the engine still will not crank, go to Step 8.

8. Check the specific gravity of the battery or its state of charge indicator. Charge the battery if necessary and if the engine now cranks, check the generator belt and the generator output as described on page 18. If the engine will not crank go to Step 9.

9. Use the analyzer as a voltmeter and connect the RED clip to the ignition switch B+ terminal. Connect the BLACK clip to a good ground. If the voltage reads 10 volts or more, replace the ignition switch. If the voltage is less than 10 volts check for loose corroded battery connections at the starter, a blown fusible link (see your service manual) or poor connections in the bulkhead connector.

SLOW CRANKING AND SOLENOID CLICKING

1. Check for battery damage, loose or corroded battery cables and their connections or a loose engine ground. If the engine still cranks slowly go to Step 2.

2. Check the specific gravity of the battery or its state of charge indicator. If battery charge is low, recharge and check for a loose alternator belt or low alternator output. If necessary, perform Alternator Output Test on page 20. Repair or replace as necessary. If engine still cranks slowly go to Step 3.

3. a. Connect the analyzer as a voltmeter by switching the main selector to the VOLTS position and sliding the VOLTS switch to 16.
   b. Connect the RED clip to the battery positive terminal and the BLACK clip to the battery negative terminal. Make good connections at these points.
   c. Turn the ignition to "START" and check the voltage. If the reading is under 9.6 volts, perform a battery load test. If the battery is OK a fault in the starter is indicated. If the reading is over 9.6 volts go to Step 4.

4. Perform the voltage drop tests described on page 28. If slow cranking or clicking continues go to Step 5.

5. a. Connect the BLACK clip to a good ground and the RED clip to the positive battery post.
   b. Turn the ignition to "START". If the voltage is over 9 volts a fault in the starter is indicated. If the voltage is less than 9 volts, the positive cable or its connections are faulty. Repair or replace as necessary.

STARTER RUNS WITH THE KEY OFF

1. Disconnect the starter solenoid control wire. On vehicles with integral starters and solenoids, remove the wire connected to the terminal marked "S". If the starter continues to run, the solenoid is latched up and should be repaired or replaced. If the starter stops go to Step 2.

2. Check for a short in the wiring harness or for a faulty ignition switch. Repair or replace as necessary.

HARD STARTING OR ENGINE CRANKS BUT WILL NOT START

Note: If engine starts and stalls, perform the STALLS/ROUGH IDLE tests.
Note: If the vehicle is equipped with an electronic ignition, also check the appropriate tests on pages 30 through 40 and those below.

1. a. Remove the air cleaner and check for sticking or binding in the choke mechanism.
   b. Verify that the choke operation is proper - closed for a cold engine, open for a warm one.
   c. Check the vacuum hoses for splits or kinks and proper connections.
   d. Check to see if the carburetor is flooded. If none of the above symptoms is found or if engine will not start after repair go to Step 2.

2. Hold the choke open and watch for gas squirting inside the carburetor while moving the throttle 3 full strokes. If 3 full squirts are observed, check the choke adjustment and if engine does not start go to Step 9. If less than 3 full squirts are observed go to Step 3.

(CONT.)

HARD STARTING OR ENGINE CRANKS BUT WILL NOT START (CONT.)

3. a. Perform the Fuel Pump volume test described on page 43. If an adequate volume is delivered, the problem is not in the fuel pump.
   b. Check the fuel filter and the carburetor for blockage. If no blockage is found, go to Step 9. If an inadequate supply of fuel is delivered go to Step 8 (for vehicles with electric fuel pumps) and go to Step 4 for all others.

4. a. Reconnect the carburetor fuel line.
   b. Disconnect the inlet hose to the fuel pump and plug it.
   c. Connect the vacuum gauge to the pump inlet.
   d. Crank or run the engine until the gauge reads maximum vacuum.
   e. Check your service manual for the proper vacuum reading specification. If the vacuum is adequate go to Step 5. If the vacuum is inadequate, replace the fuel pump. If after repair the engine will not start go to Step 5.

5. a. Reconnect the inlet hose.
   b. Check the fuel lines for kinks or poor connections. Repair as necessary. If the hard starting continues go to Step 6.

6. a. Disconnect the fuel line at the gas tank and connect the vacuum gauge to the line.
   b. Crank the engine until gauge reads a maximum value. Stop the engine. If the reading is adequate (as specified in your owners manual) go to Step 8. If the reading is less than specified go to Step 7.

7. a. Disconnect the inlet hose from the steel line (if so equipped.)
   b. Connect the vacuum gauge to the inlet hose.
   c. Crank or run the engine until the reading is maximum. Stop the engine. If the reading is less than specified, replace the hose. If the reading is adequate, repair or replace the fuel line.

8. If the vehicle is equipped with an electric fuel pump, check the fuel lines for kinks. If lines are OK perform the following repair. With the guidance of your service manual remove the tank unit, replace the strainer and clean the fuel tank. If hard starting continues go to Step 9.

9. Check the ignition wires, boots, cap and coil for damage, deterioration, loose connections and carbon tracking. Repair or replace as necessary. If the hard starting continues go to Step 10.

10. a. With the engine off, remove the distributor cap and check it for moisture, dust, cracks, burns, etc.
    b. Check the distributor assembly for a worn distributor shaft, bare or shorted wires, a loose condenser, faulty points or a faulty coil. Repair or replace as necessary. If the hard starting continues go to Step 11.

11. Remove the spark plugs and check for cracks, wear, improper gap, burned electrodes or heavy deposits. Repair or replace as necessary.

STARTER SPINS BUT ENGINE WILL NOT CRANK

1. Remove the flywheel cover and inspect the flywheel gear teeth and the starter drive teeth. If the teeth are OK, clean and lubricate the armature shaft and/or replace the starter drive. If the teeth are not OK, repair or replace the damaged gear, clean and lubricate the armature shaft and/or replace the starter drive.

STALLING OR ROUGH IDLE (COLD)

Perform these checks if the condition occurs when the engine is cold.

PRELIMINARY: Remove the air cleaner - engine off.

1. a. Inspect the vacuum hoses (including those on the air cleaner) and look for splits, kinks and proper connections.
   b. Check for vacuum leaks at the carburetor mounting and intake manifold.
   c. Check the spark plug wires for checking, cracking or hardness as well as proper connections. If repair of the above has not cured the problem go to Step 2.

2. a. Check the carburetor, choke and throttle linkages. Check the fast idle cam for sticking or binding.
   b. If the carburetor shows evidence of flooding, make sure that the needle valve is seating properly and that the float level is correct. Repair if necessary.
   c. Be sure that the choke closes for cold engine starting. If not, repair the choke assembly. If problem continues go to Step 3.

3. If vehicle does not have a vacuum break assembly go to Step 4.
   a. Check for movement of the vacuum break assembly linkage while removing and reinstalling the vacuum hose. The linkage should move. If the linkage moves go to Step 4. If the linkage does not move check the vacuum line as described in Vacuum Gauge Testing on page 42. If the unit has adequate vacuum replace the vacuum break assembly. If this repair has not cured the stalling and rough idle go to Step 4.

4. Check the fast idle adjustments according to manufacturer's specifications.
   a. With the engine off connect the analyzer as described on page 7.
   b. Start the engine and adjust the fast idle speed to the specification on the Tune Up decal in the engine compartment. If the problem continues after adjustment go to Step 5.

5. a. Disconnect the vacuum advance hose to the distributor and plug it.
   b. Connect the analyzer as shown on page 7.
   c. Start the engine and run it at idle speed.
   d. Check the dwell setting as described on page 10. Set the dwell if necessary.
   e. Check the timing as described on page 15 and adjust if necessary. If stalling or rough idling continues go to Step 6.

6. Note: This step and the next one check the operation of a vacuum operated damper door in the air cleaner inlet. If your vehicle has a thermal operated door, check your service manual for the specific testing procedure. Remove the cover and air filter element. Start engine. With the engine running and warm, perform the following test.
   a. Place a cold wet rag over the damper door sensor. The damper door should close. When the rag is removed it should reopen. If the door operates properly go to Step 8. If the door closes, but will not reopen when the rag is removed, replace the sensor. If the door does not close go to Step 7.

7. Apply vacuum directly to the vacuum motor. If the door closes replace the sensor. If the door does not close replace the vacuum motor. If after these repairs stalling or rough idling continue GO TO STEP 8.

8. With the warm engine idling between 1400 and 1600 RPM and with the shift lever in "PARK" disconnect the vacuum hose to the EGR valve. RPM should increase. When reconnected RPM should decrease. If there is no RPM decrease repair or replace the EGR. If the RPM decreases or if repair of EGR does not cure the stalling and rough idling go to Step 9.

9. Further testing of the pollution control equipment is indicated. Check your service manual for details.

STALLING/ROUGH IDLE (HOT)

1. a. Inspect the vacuum hoses (including those on the air cleaner) and look for splits, kinks, and proper connections.
   b. Check for vacuum leaks at the carburetor mounting and intake manifold.
   c. Check the spark plug wires for checking, cracking or hardness as well as proper connections. If repair of the above has not cured the problem go to Step 2.

2. a. Disconnect the vacuum advance hose to the distributor and plug it.
   b. Connect the analyzer as shown on page 7.
   c. Start the engine and run it at idle speed and check for flooding. Repair as necessary.
   d. Check the dwell setting as described on page 10. Set the dwell if necessary.
   e. Check the timing as described on page 15 and adjust if necessary. If the stalling or rough idling continue go to Step 3.

3. Note: This step and the next one check the operation of a vacuum operated damper door in the air cleaner inlet. If your vehicle has a thermal operated door check your service manual for the specific testing. Remove the cover and air filter element. Start engine. With the engine running and warm, perform the following test.
   a. Place a cold wet rag over the damper door sensor. The damper door should close. When the rag is removed it should reopen. If the door operates properly go to Step 5. If the door closes, but will not reopen when the rag is removed replace the sensor. If the door does not close go to Step 4.

4. Apply vacuum directly to the vacuum motor. If the door closes replace the sensor. If the door does not close replace the vacuum motor. If after these repairs stalling or rough idling continue go to Step 5.

5. Check the operation of the PCV valve as described on page 42. Repair or replace if necessary. If the stalling or rough idle continues go to Step 6.

6. With the warm engine idling between 1400 & 1600 RPM and with the shift level in "PARK" disconnect the vacuum hose to the EGR valve. RPM should increase. When reconnected RPM should decrease. If there is no RPM decrease repair or replace the EGR. If the RPM decreases or if repair of EGR does not cure the stalling and rough idling go to Step 7.

7. Adjust idle mixture as described on page 17. If stalling or rough idling persist go to Step 8.

8. With the air cleaner removed and the engine running, add top engine cleaner to the carburetor to remove carbon. If rough idling continues, perform the compression test described on page 44.

CUTS OUT

Note: If the vehicle is equipped with an electronic ignition, check the appropriate tests on pages 30 through 40.

1. a. Check the ignition wires, boots, distributor cap and coil for damage, deterioration, loose connections or carbon tracking.
   b. Remove the distributor cap and check the cap assembly for moisture, dust, cracks, burns, etc.
   c. Check the distributor assembly for a worn distributor shaft, bare or shorted wires, a loose condenser, faulty points or a faulty coil. Repair as necessary. If the cutting out continues go to Step 2.

2. Remove the spark plugs and check for cracks, wear, improper gap, burned electrodes or heavy deposits. Repair or replace as necessary. If the cutting out continues go to Step 3.

3. With the help of your service manual, check the fuel filter. Replace as necessary. If the problem continues go to Step 4.

4. Perform the Fuel Pump volume test described on page 43. If an adequate volume is pumped, the problem is not the fuel pump. If an inadequate volume is delivered with an electric fuel pump go to Step 9. If an inadequate volume is delivered for all other fuel pumps go to Step 5.

5. a. Reconnect the carburetor fuel line.
   b. Disconnect the inlet hose to the fuel pump and plug it.
   c. Connect the vacuum gauge to the pump inlet.
   d. Crank or run the engine until gauge reads maximum vacuum.
   e. Check your service manual for the proper vacuum reading specification. If vacuum is adequate go to Step 6.

   If vacuum is inadequate, replace the fuel pump. If after repair cutting out is still a problem go to Step 6.

6. a. Reconnect the inlet line.
   b. Check the fuel lines for kinks, splits or poor connections. Repair as necessary. If cutting out continues go to Step 7.

7. a. Disconnect the fuel line at the gas tank and connect the vacuum gauge to the line.
   b. Crank or run the engine until gauge reads maximum value. Stop the engine. If the reading is adequate as specified in your service manual go to Step 9. If the reading is below specifications go to Step 8.

8. a. Disconnect the inlet hose from the steel line (if so equipped.)
   b. Connect the vacuum gauge to the inlet hose.
   c. Crank or run the engine until the reading is maximum. Stop the engine. If the reading is less than specified, replace the hose. If the reading is adequate, repair or replace the fuel line.

9. If the vehicle is equipped with an electric fuel pump check the fuel lines for kinks. If lines are OK perform the following repair. With the guidance of your service manual remove the tank unit, replace the strainer and clean the fuel tank.

HESITATION

1. Remove the air cleaner and with the engine off perform the following checks.
   a. Inspect the vacuum hose (including those on the air cleaner) and look for splits, cracks or improper connections. Repair as necessary.
   b. Check for vacuum leaks at the carburetor mounting and intake manifold. Repair as necessary.
   c. Check the spark plug wires for checking, cracking or hardness as well as for proper connection. Repair as necessary.
   If none of the above conditions is found, or if their repair is ineffective and warm engine hesitation continues go to Step 3. If hesitation occurs for a cold engine go to Step 2.

2. With the engine turned off, remove the air cleaner and visually inspect the carburetor, choke and throttle linkages and the fast idle cam. Look for signs of sticking or bending. Repair as necessary. If no sticking is observed or if hesitation continues, go to Step 3.

3. With the engine OFF hold the choke open and look for a gas squirt while moving the throttle. If it squirts go to Step 4. If it doesn't squirt go to Step 5.

4. Check the accelerating pump linkage adjustment as described in your service manual. Repair as necessary. If hesitation persists after this test go to Step 6.

5. With the aid of your service manual, remove the top of the carburetor and replace the accelerating pump. Recheck the accelerating pump system and its linkage adjustment and the float setting. Repair as necessary. If hesitation continues go to Step 6.

6. a. Disconnect the vacuum advance hose to the distributor and plug it.
   b. Connect the analyzer as shown on page 7.
   c. Start the engine and run it at idle speed.
   d. Check the dwell setting as described on pages 10 and 11. Set the dwell if necessary.
   e. Check the timing as described on page 15 and adjust if necessary. If the hesitation problem continues go to Step 7.

7. Note: This step and the next one check the operation of a vacuum operated damper door in the air cleaner inlet. If your vehicle has a thermal operated door, check your service manual for the specific test procedure. Remove the cover and air filter element. Start engine. With the engine running and warm, perform the following test.
   a. Place a cold wet rag over the damper door sensor. The damper door should close. When the rag is removed, it should reopen. If the door closes, but will not reopen when the rag is removed, replace the sensor. If the door does not close go to Step 8.

8. Apply vacuum directly to the vacuum motor with a hand vacuum pump. If the door closes, replace the sensor. If the door does not close, replace the vacuum motor.

SURGING

1. a. Inspect the vacuum hoses (including those on the air cleaner) and look for splits, kinks and proper connections.
b. Check for vacuum leaks at the carburetor mounting and intake manifold.
c. Check the spark plug wires for checking, cracking or hardness as well as proper connections.
If repair of the above has not cured the problem go to Step 2.

2. Note: This step and the next one check the operation of a vacuum operated damper door in the carburetor inlet. If your vehicle has a thermal operated door, check your service manual for the specific testing procedure.
Remove the cover and air filter element. Start engine. With the engine running and warm, perform the following test.
a. Place a cold wet rag over the damper door sensor. The damper door should close. When the rag is removed, it should reopen. If the door operates properly go to Step 4. If the door closes, but will not reopen when the rag is removed, replace the sensor. If the door does not close go to Step 3.

3. Apply vacuum directly to the vacuum motor with a hand vacuum pump. If the door closes replace the sensor.
If the door does not close replace the vacuum motor. If after these repairs stalling or rough idling continue go to Step 4.

4. a. Disconnect the vacuum advance hose to the distributor and plug it.
b. Connect the analyzer as shown on page 7.
c. Start the engine and run it at idle speed.
d. Check the dwell setting as described on page 10. Set the dwell if necessary.
e. Check the timing as described on page 15 and adjust if necessary. If surging problem continues go to Step 5.

5. With the timing light still connected, check the centrifugal advance as described on page 16. Repair as necessary. If the surging problem continues go to Step 6.

6. With the engine stopped apply 15 inches of vacuum to the distributor with a hand vacuum pump and gauge. If the reading drops within 15 seconds, replace the vacuum advance. If the reading is steady for 15 seconds, but surging continues go to Step 7.

7. With the aid of your service manual check the fuel filter and replace if necessary. If surging continues go to Step 8.

8. With the engine stopped, remove the spark plugs and check them for cracks, wear, improper gap, burned electrodes, or heavy deposits. Repair or replace as necessary. If surging continues go to Step 9.

9. Perform the Fuel Pump volume test described on page 43. If an adequate volume is pumped the problem is not in the fuel pump. If an inadequate volume is delivered with an electric fuel pump go to Step 14. If an inadequate volume is delivered for all other fuel pumps go to Step 10.

10. a. Reconnect the carburetor fuel line.
b. Disconnect the inlet hose to the fuel pump and plug it.
c. Connect the vacuum gauge to the pump inlet.
d. Crank or run the engine until gauge reads maximum vacuum.
e. Check your service manual for the proper vacuum reading specification. If vacuum is adequate go to Step 11. If vacuum is inadequate, replace the fuel pump. If after repair surging is still a problem go to Step 11.

11. a. Reconnect the inlet line.
b. Check the fuel lines for kinks, splits or poor connections. Repair as necessary. If surging continues go to Step 12.

(CONT.)

SURGING (CONT.)

12. a. Disconnect the fuel line at the gas tank and connect the vacuum gauge to the line.
    b. Crank or run the engine until gauge reads maximum value. Stop the engine. If the reading is adequate as specified in your service manual go to Step 14. If the reading is below specifications go to Step 13.

13. a. Disconnect the inlet hose from the steel line (if so equipped.)
    b. Connect the vacuum gauge to the inlet hose.
    c. Crank or run the engine until the reading is maximum. Stop the engine. If the reading is less than specified, replace the hose. If the reading is adequate, repair or replace the fuel line.

14. If the vehicle is equipped with an electric fuel pump check the fuel line for kinks. If lines are OK perform the following repair. With the guidance of your service manual remove the tank unit, replace the strainer and clean the fuel tank. If surging continues go to Step 15.

15. With the aid of your service manual, remove the carburetor, clean and re-adjust it.

SLUGGISHNESS/SPONGINESS

1. a. Remove the air filter and cover.
    b. Check the air filter and replace if necessary. If sluggishness continues go to Step 2.

2. a. With the engine stopped, press the accelerator pedal to the floor and check for wide open throttle, full choke opening and free operation of air valve (if so equipped). Repair as necessary. If no problem is found or repair is ineffective and sluggishness continues go to Step 3.

3. a. Disconnect and plug the vacuum advance hose to the distributor.
    b. Connect analyzer as shown on page 7.
    c. Check dwell as described on page 10 and adjust if necessary.
    d. Check timing as described on page 15 and adjust it if necessary.
    If after making these checks, sluggishness continues go to Step 4.

4. a. With the timing light still connected, perform the centrifugal advance test as described on page 16. If the mark advances, but sluggishness continues go to Step 5.

5. a. With the engine stopped apply 15 inches of vacuum to the distributor with a hand vacuum pump and gauge. If the reading drops within 15 seconds, replace the vacuum advance. If the reading is steady for 15 seconds and sluggishness continues go to Step 6.

6. Remove the air filter and cover and with engine running and warm perform the following damper door test. Note: This test step and Step 7 check the operation of a vacuum operated damper door. If your door is different, see your service manual for the specific testing procedure.
    a. Place a cold wet rag over the damper door sensor. The damper door should close. It should open when the rag is removed. If the door operates properly go to Step 8. If the door closes, but will not reopen when the rag is removed - replace the sensor. If the door does not close go to Step 7.

7. For vacuum controlled damper doors apply vacuum directly to the vacuum motor. If the door closes, replace the sensor. If the door does not close, replace the vacuum motor. If after these repairs, sluggishness persists go to Step 8.

8. With the engine stopped, remove the spark plugs and check them for cracks wear, improper gap, burned electrodes or heavy deposits. Repair or replace as necessary. If sluggishness continues go to Step 9.

(CONT.)

SLUGGISHNESS/SPONGINESS (CONT.)

9. With the guidance of the vehicle service manual, remove the carburetor top and check for power piston freeness, dirt in the jets, proper float adjustment, metering rods and valves. Repair as necessary. If sluggishness persists go to Step 10.

10. With the warm engine idling between 1400 and 1600 RPM and with the shift lever in "PARK", disconnect the vacuum hose to the EGR valve. The RPM should increase. When the hose is reconnected RPM should decrease. If there is no RPM decrease repair or replace the EGR. If the RPM decreases or if repair of the EGR does not cure the sluggishness go to Step 11.

11. Perform the compression check as described on page 44. Make repairs as necessary.

DETONATION (Pinging)

1. a. With the engine off look for signs of overheating by checking for low coolant level, loose fan belt or restricted air flow. Repair as necessary. If the problem continues go to Step 2.

2. a. Disconnect and plug the vacuum advance hose to the distributor.
b. Connect the analyzer as shown on page 7.
c. Start the engine and run it at idle speed.
d. Check the dwell setting as described on page 10. Use the Tune-up decal located in the engine compartment as a guide. Set the dwell if necessary.
e. Check the timing as described on page 15. Set it to the specification if necessary. If detonation continues, go to Step 3.

3. Check the centrifugal advance mechanism as described on page 16. Repair as necessary. If the advance mechanism is OK and detonation continues go to Step 4.

4. With the air cleaner removed and the engine running, add top engine cleaner to the carburetor to remove carbon.

DIESELING

1. With the engine turned off, remove the air cleaner and visually inspect the carburetor, choke and throttle linkages and the fast idle cam. Look for signs of sticking or binding. Repair as necessary. If no sticking is observed or dieseling continues go to Step 2.

2. a. Disconnect the vacuum advance hose to the distributor and plug it.
b. Connect the analyzer as shown on page 7.
c. Start the engine and run it at idle speed.
d. Check the dwell setting as described on page 10. Set the dwell if necessary.
e. Check the timing as described on page 15 and adjust if necessary. If the dieseling problem continues go to Step 3.

3. Check the operation of the anti-dieseling solenoid. See your service manual for the specific method. Follow this basic guideline for electrically operated anti-dieseling solenoids.
a. With the engine running, disconnect the wire to the idle solenoid. The RPM should drop. If RPM does drop go to Step 5. If the RPM does not drop go to Step 4.

4. a. Set the analyzer to measure volts. Connect the BLACK clip to a good engine ground, and the RED clip to the disconnected wire of the solenoid. The voltmeter should read 8 volts or more. If the voltage is lower than 8 volts, check the wire and its connections. If the voltage is 8 volts or more, replace the solenoid. If after repair, the condition still exists go to Step 5.

5. With the engine running and the air cleaner removed, add top engine cleaner to the carburetor to remove carbon.

MISSING

1. Remove the air cleaner and with the engine off perform the following checks.
   a. Inspect the vacuum hoses (including those on the air cleaner) and look for splits, cracks, kinks or improper connections. Repair as necessary.
   b. Check for vacuum leaks at the carburetor mounting and intake manifold. Repair as necessary.
   c. Check the spark plug wires for checking, cracking or hardness as well as for proper connection. Repair as necessary.
   d. Remove the distributor cap and check for moisture, dust, cracks, burns or carbon tracks. Replace as necessary.
   If none of the above conditions is found or if their repair is ineffective and missing still continues go to Step 2.

2. Note: This step requires plug wires to be disconnected at the plug end. Some vehicle manufacturers warn against this practice. Check your service manual before performing this test and follow the test procedure shown in the manual.
   a. Disconnect the air cleaner vacuum hose and plug the vacuum source.
   b. Disconnect the EGR hose (if the vehicle is so equipped) and plug it.
   c. Connect the analyzer as shown on page 7 and monitor the tachometer low RPM scale.
   d. Start the engine.
   e. Using high voltage insulating pliers remove one plug wire at a time. If there is an RPM drop for every cylinder GO TO THE ROUGH IDLE sequence of tests. If one or more cylinders does not show an RPM drop go to Step 3.

3. a. With the engine off, remove the plug in question and check for cracks, wear, improper gap, burned electrodes, or heavy deposits. Repair or replace as necessary. If the plug is OK go to Step 4.

4. Use the analyzer's ohmmeter to check the spark plug wire as shown on page 24. Replace if necessary. If the wire is OK go to Step 5.

5. Perform the compression check on the questionable cylinder as described on page 44. Repair as necessary. If compression is OK go to Step 6.

6. Check for bent push rods, worn rocker arms, broken valve springs and worn cam shaft lobe as described in your service manual.

POOR GAS MILEAGE

1. a. Remove and inspect the air filter and replace if necessary.
   b. Check for obvious gas leaks including the gas tank cap seal and check valve.
   c. Check all the vacuum hoses (including those on the air cleaner) for splits, cracks, kinks and proper connections.
   d. Check for vacuum leaks at the carburetor mounting and intake manifold.
   e. Check the ignition wires for checking, cracking, hardness and proper connections. If repair of the above conditions does not improve the gas mileage go to Step 2.

2. Remove the air filter and cover, and with the engine running and warm perform the following damper door test. Note: This test step and the next one check the operation of a vacuum operated damper door in the air cleaner inlet. If your vehicle has a thermal operated door see your service manual for specific testing procedure.
   a. Place a cold wet rag over the damper door sensor. The damper door should close. It should open when the rag is removed. If the door operates properly go to Step 4. If the door closes, but will not reopen when the rag is removed replace the sensor. If the door does not close go to Step 3.

(CONT.)

POOR GAS MILEAGE (CONT.)

3. For vacuum controlled damper doors apply vacuum directly to the vacuum motor. If the door closes, replace the sensor. If the door does not close, replace the vacuum motor. If after these repairs, sluggishness persists go to Step 4.

4. With the aid of your service manual, check the choke linkage and its setting. If the problem continues go to Step 5.

5. a. Disconnect the vacuum advance hose to the distributor and plug it.
b. Connect the analyzer as shown on page 7.
c. Start the engine and run it at idle speed.
d. Check the dwell setting as described on page 10. Set the dwell if necessary.
e. Check the timing as described on page 15 and adjust if necessary. If the poor mileage continues go to Step 6.

6. With the timing light still connected, check the operation of the centrifugal advance mechanism as described on page 16. Repair or replace as necessary. If the gas mileage does not improve go to Step 7.

7. a. With the engine stopped apply 15 inches of vacuum to the distributor. Use a vacuum source and gauge. If the reading drops within 15 seconds, replace the vacuum advance. If the reading is steady for 15 seconds, go to Step 8.

8. With the engine stopped, remove the plugs and check them for cracks, wear, improper gap, burned electrodes and heavy deposits. Repair or replace as necessary. If adjustments have been made, recheck the gas mileage. If no adjustments have been made, go to Step 9.

9. With the aid of your service manual, remove the top of the carburetor and check for power piston freeness, dirt in jets, proper float adjustment, metering rods, power valves. Repair as necessary.

GENERATOR LIGHT "ON" - ENGINE RUNNING

1. With the engine stopped turn the ignition ON and check all the indicator lights. If the other lights are OFF, replace the fuse for the gauges and go to Step 2. If the other lights are ON, go to Step 3.

2. Start the engine. If the fuse for the gauges blow, check your service manual for procedure to repair shorts in the related circuits.

3. a. Check for loose or missing generator belt, or loose wiring connections at the generator. Repair or replace as necessary.
b. Turn the ignition ON. If the generator light stays on go to Step 4.

4. Note: This step describes the GM test procedure. Refer to your service manual for specific details.
a. Disconnect the two-wire connector at the generator. If the generator light stays on, repair a short in the generator light wiring. See your service manual for details. If the light goes off go to Step 5.

5. Perform the charging system tests on pages 18 through 22 to determine whether the regulator or the generator is at fault.

GENERATOR LIGHT STAYS ON WITH THE IGNITION OFF

1. Disconnect the two-wire connector at the generator. If the generator light stays ON, a short between the two wires is indicated. Repair as necessary.
If the generator light goes OFF, a fault in the rectifier bridge is indicated. Check the diodes as shown on page 25.

GENERATOR LIGHT "OFF" IGNITION "ON" ENGINE NOT RUNNING

1. a. Turn the ignition switch to the "ON" position and check all the indicator lights. If the other lights are OFF replace the gauges fuse and recheck the Generator light. If the other lights are "ON", go to Step 2.

2. Note: This step describes the GM test procedure. Refer to your service manual for specific details if necessary.

   a. Disconnect the two-wire connector at the generator and with a piece of wire ground one wire.
   b. Observe the generator light. If the generator light is ON, repair the generator. If the light is OFF, replace the generator light bulb.

BATTERY DOES NOT STAY CHARGED (GENERATOR INDICATOR LIGHT OK)

1. a. Check the specific gravity of the battery or its state of charge indicator if it is so equipped. Charge the battery if necessary.
   b. Check for a loose generator belt, loose or corroded battery cables or their connections and loose wire connections at the generator belt. Repair or replace as necessary. If the battery fails to hold charge go to Step 2.

2. a. Connect the analyzer as shown on page 7 with the shunt in position.
   b. Make sure that no accessories are left on, Ignition OFF, doors closed, and the underhood light and clock disconnected.
   c. Open the shunt bar and observe the meter. If the meter moves and shows a reading this indicates that there is a drain on the battery. See your service manual for the steps to take in tracing and correcting this drain. If there is no drain go to Step 3.

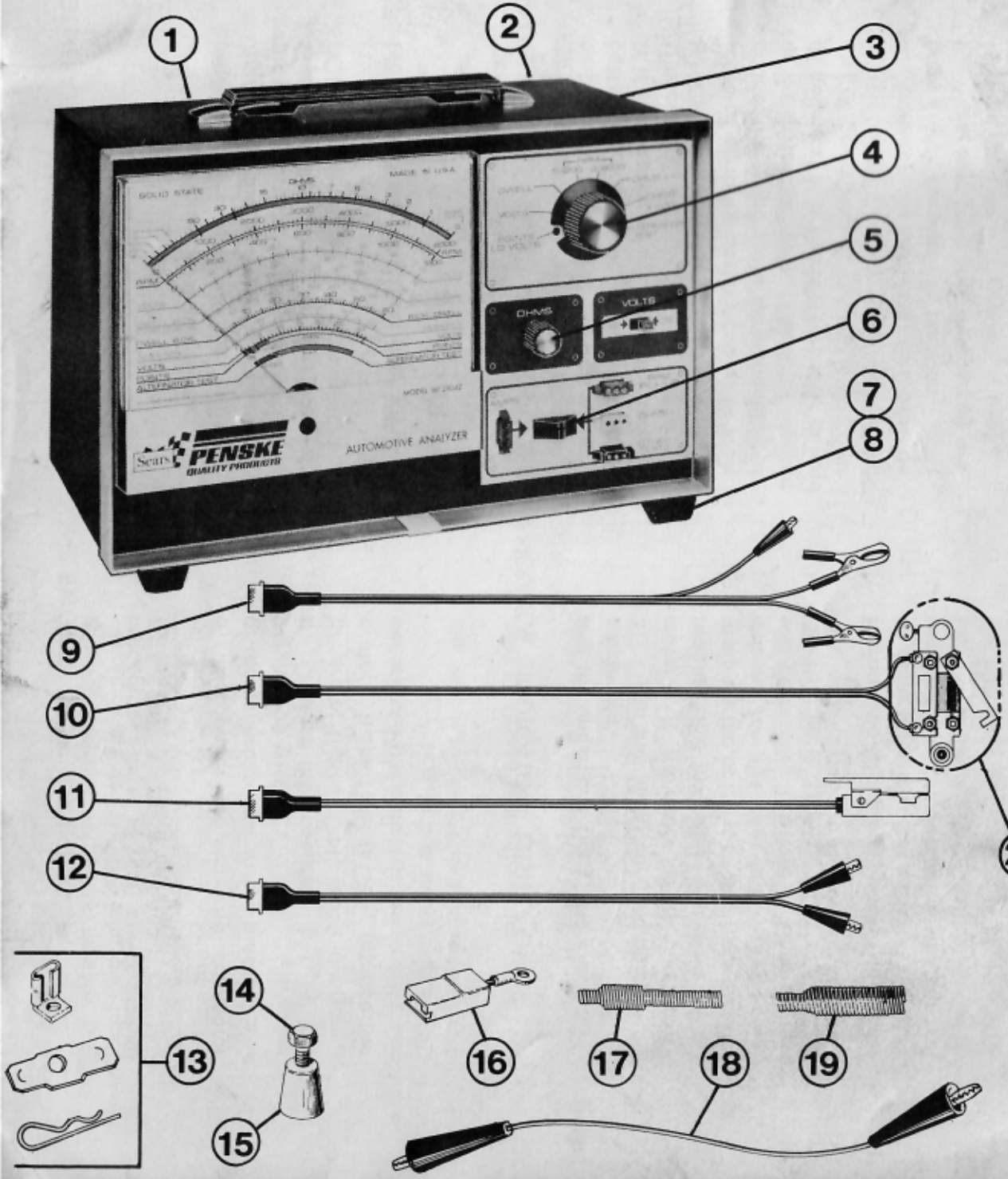
3. Perform the Charging System Volts Test on page 18. This test will provide the required steps to determine whether the fault is in the regulator, alternator or in the battery.

BATTERY OVERCHARGED (USES TOO MUCH WATER)

1. Test the battery using the Load Test procedure shown in your service manual. If the battery is OK, go to Step 2.

2. Perform the Charging System Volts Test on page 18. This test will provide the required steps to determine whether the fault is in the regulator or in alternator.

repair parts AUTOMOTIVE ANALYZER



Key #	Part No.	Description
1	20-100	Battery, 9V. See Page 4
2	20-101	Battery "D" Cell 1-1/2V.
3	1000-474	Housing Assembly
4	450-132	Knob, Selector
5	450-131	Knob, Ohms
6	450-130	Glamor Cap
7	400-290	Foot Rear
8	400-529	Foot Front
9	38-512	Cable Assembly, Other Tests
10	38-514	Cable Assembly, Amps
11	38-568	Cable Assembly, RPM
12	38-513	Cable Assembly, Ohms
13	1000-425	Ignition Adaptor Kit
14	260-171	Screw, Hex 3/8-16 x 1-1/4 Lg.
15	180-618	Battery Adaptor- Male
16	1000-248	Alternator Adaptor
17	180-298	Adaptor- Spark Plug- Foreign
18	38-396	Wire Adaptor (Jumper)
19	180-293	Adaptor- Spark Plug- US
20	1000-447	Shunt Assembly (Complete)
21	290-107	Nut #10-32 (6)
22	1000-252	Shunt and Terminal Assembly
23	180-564	Switch Bar, Shunt
24	210-110	Washer, Flat- No. 10 (4)
25	25-185	Resistor, 1/4 Ohm
26	1000-251	Battery Adaptor Assembly
27	260-183	Thumb Screw
28	2-1530	Instruction Manual